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IN

AMBER CANE

AND THE

ENSILAGE OF FODDERS,

AT THE

EXPERIMENTAL FARM,

MADISON, WIS., 1881.

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REPORT.

To His Excellency, J. M. Rusk, *Governor:*

In conformity to chapter 211 of the general laws of 1881, I herewith present a report of the experiments in amber cane and ensilage of fodders, conducted upon the university experimental farm during the past season.

Most fortunately, Mr. Magnus Swenson was secured as chemist in these experiments, and too much credit cannot be given him for his untiring zeal in the difficult task to which he was assigned. Such an experiment as securing sugar from amber cane in anything like a practical way is a most difficult undertaking. Every step in the process is along an unknown road, and the many failures in past years show that scores of persons who thought they were certain of success, only attained defeat.

Fortunately Mr. Swenson understands machinery as well as chemistry, and was enabled to design and superintend the construction of the machinery used. By this means a great saving was effected in the cost of machinery needed. Had it been otherwise, the funds would not have been sufficient for the work.

I present Mr. Swenson's report as handed to me, believing that in it, those interested in amber cane will find information that cannot but prove of great value to them. The fact that good marketable sugar can be obtained from amber cane at the rate of 1,000 pounds to the acre, by methods even more practicable when used on a large scale than in the present case, is a cause for gratification, I think.

It is proposed to distribute samples of syrup and sugar obtained in the experiments, in such a way that they can be seen at all the agricultural gatherings held this winter, throughout the state.

Having experimented but a single season, it is needless to say that much remains to be done yet, and many problems are still awaiting solution.

In addition to the experiments, I have tried to learn the condition of the industry throughout the state and have taken steps to familiarize our farmers with what we are trying to do.

In April last a twelve-page circular relative to amber cane was prepared and 3,000 copies distributed.

This fall 1,500 copies of a circular letter, making inquiries regarding the cane crop, were prepared and sent to all whom I thought could aid us. In answer to these circulars I have replies from 180 manufacturers of amber cane syrup, who report having made about 350,000 gallons of syrup this year. A list of these manufacturers, together with amount of syrup made by each, is herewith given. Other valuable information from these reports is given in its proper place.

In regard to the second experiment, the ensilage of fodders, permit me to say that a silo was built and filled last summer, and experiments are now in progress to determine the value of the ensilage. So far the indications are very favorable, but it is too soon to make any definite statements. As complete a report as possible is herewith presented. It is planned that Mr. Swenson investigate the subject, from the chemical side, this winter, and upon this point much remains yet to be known.

As required by the act above named, I have made a detailed statement of the moneys expended up to the present. It will be seen that we have not yet expended the sum granted.

Most respectfully submitted,

W. A. HENRY,

Prof. Agriculture, University of Wisconsin.

EXPERIMENTAL FARM, UNIVERSITY OF WISCONSIN, Madison, Wis., December 31, 1881.

EXPERIMENTS WITH SORGHUM CANES.

By Magnus Swenson.

The chief object of the experiments conducted during the past season has been to demonstrate the practicability of making sugar from cane grown in this state. For this reason the work has been carried on in a thoroughly practical manner. My results are not based on theory; they do not show what might be obtained, but what has actually been done. The amount of sugar obtained is not deduced from the amount present in the cane or syrup, but represents what has actually been crystallized and separated as sugar.

MACHINERY.

The apparatus used consisted of one horizontal mill, made by the Madison Manufacturing Company; one ten horse-power steam boiler; one defecator of galvanized sheet iron, 3 feet high, 2.5 feet in diameter, and heated by a steam coil, made of 1-inch gas pipe; two galvanized iron evaporating pans, the larger 6 feet long, 3 feet wide, 1 foot deep; the smaller 4 feet long, 2 feet wide, 8 inches deep, both heated by steam coils; one globular vacuum pan 30 inches in diameter; one wet air pump for exhausting the vacuum pan; one centrifugal machine for separating the sugar from the syrup, 1½ feet in diameter, and 4 inches deep; one small steam pump for feeding the boiler, and running the vacuum pan and centrifugal machine.

CANE SUGAR AND GLUCOSE.

Before passing on to the actual experiments, a few pages will be devoted to the general properties of cane sugar, and the substances occurring with it in the cane juice. The average cane contains about 85 per cent. of juice and 15 per cent. of dry bagasse. The juice from the average cane obtained on the farm consisted of 9.5 per cent. cane sugar, 3.2 per cent. glucose, 2.3 per cent. organic acid and vegetable matter, and 8.5 per cent. water. Cane sugar is a compound substance composed of 12 parts carbon, 22 parts hydrogen, 11 parts oxygen; or since 1 part

oxygen and 2 parts hydrogen form water, we may consider cane sugar to be made up of 12 parts carbon and 11 parts water.

Glucose, or grape sugar as it is also called, is composed of 12 parts carbon, 24 parts of hydrogen, 12 parts of oxygen, or 12 parts carbon and 12 parts water. The only difference between the two is 1 part of water. If a solution of cane sugar in water is heated with a small quantity of almost any acid, it takes up one more part of water, and thus becomes changed to glucose. Almost the same thing takes place when a solution of cane sugar is acted upon by a ferment, such as yeast, or even by simply heating for some time, large quantities of the crystallizable cane sugar are changed. The one important thing in the boiling down of cane juice is to guard against this change. As seen before, the destruction of cane sugar may be induced in three different ways: 1st. By the presence of an acid. 2d. By the presence of a ferment. 3d. By high and prolonged heat. We will discuss them in order.

PRESENCE OF AN ACID.

All cane juice contains a considerable proportion of free organic acids. If, therefore, the juice be boiled down without first neutralizing these acids, a large part of the cane sugar will be changed into glucose. The amount of cane sugar destroyed may be seen from the following experiment: Six hundred pounds juice, containing 9.96 per cent. cane sugar and 3.45 per cent. glucose, was taken directly from the mill and boiled down to syrup. The syrup was found to contain 22.4 per cent. cane sugar and 56.3 per cent. glucose. If no inversion had taken place, the syrup should have contained 58.3 per cent. cane sugar; so we see that 61.6 per cent. of all the cane sugar originally in the juice had been changed into glucose. Glucose has only one-third the sweetening power of cane sugar, and its presence prevents, to a large extent, the crystallization of cane sugar. The light-colored, putty-like deposit in amber syrup, which is often mistaken for cane sugar, is glucose.

USE OF LIME.

If lime is added to the juice it will combine with and neutralize the acid, and this union of the lime and acid forms a new

substance, which becomes, to a large extent, insoluble, and is removed with the scum, what remains in the solution having no effect whatever on the cane sugar. But here we meet with another difficulty. If more lime than is necessary to neutralize the acid has been added, although the excess has no effect whatever on the cane sugar, it will at once begin to decompose the glucose, changing it into a series of very dark and bitter products, which will impart a dark color, and a bitter, burnt taste to the syrup. Fortunately we are in the possession of a very simple test which tells when lime enough has been added. If a piece of blue litmus paper is dipped into water containing a small quantity of acid, it at once turns red; and if a piece of red litmus paper is dipped into water made slightly alkaline by the addition of a little lime water, it at once turns blue. If, now, to a portion of the acidified water we add gradually some lime water, we will soon arrive at a point when the solution will have no effect on the color of either red or blue litmus; in other words, it is neither alkaline nor acid, but neutral. This will be treated of again under the head of defecation.

FERMENTATION.

The next thing which tends to destroy the cane sugar is fermentation. This process begins almost immediately after the juice leaves the mill, and when the weather is warm large quantities of sugar are lost in this way. Fermentation is at once arrested by heating the juice to near the boiling point. Cane juice should therefore never be allowed to remain standing any length of time, but should be defecated as soon as possible after coming from the mill.

HIGH TEMPERATURE.

High and prolonged heat is very destructive to crystallizable cane sugar. At first the temperature will not vary much from that of boiling water, or 212° F., but as it becomes more and more concentrated the boiling point gradually rises, until, when the syrup is thick enough for sugar making, the boiling point is from 232° to 234°. The destruction of sugar takes place long before this point is reached. To get the best results the syrup should not be boiled in an open pan after it reaches a density of 20° B.,

but should then be transferred to the vacuum pan. During the first part of the boiling in this pan the temperature should not exceed 170° F., and when the syrup becomes denser a more complete vacuum should be maintained so as to boil it about 140° F.; in fact, the lower the temperature the better.

The varieties of cane raised on the farm during the past season were confined to the Early Amber, Early Orange and Honduras. Of these the Early Amber is unquestionably the best for sugar making, and our experiments were confined largely to this variety. The total amount of juice in this cane is about 85 per cent. of the total weight of the stalks, and the juice contained 9.20 per cent. cane sugar and 3.4 per cent. glucose. This content of sugar represents the average of not less than 200 pounds of stalks stripped and topped, the greater part of which were lodged. Moreover, the land on which this cane was grown was quite low, and the soil a cold, clay loam, not well adapted for cane growing. Taking these facts in connection with the bad season, it must be looked upon as below the average yield.

DEVELOPMENT.

The development of the Early Amber cane raised on this farm may to some extent be seen from the following analyses, which have been made by me during the summer and fall:

August 10	Cane sugar	3.00
	Glucose	4.50
August 20	Cane sugar	8.20
	Glucose	5.10
September 6	Cane sugar	9.22
	Glucose	4.20
September 14	Cane sugar	9.96
	Glucose	3.45
September 17	Cane sugar	9.86
	Glucose	3.32
September 20	Cane sugar	10.02
	Glucose	3.23
September 22	Cane sugar	11.05
	Glucose	2.60
September 29 [1]	Cane sugar	8.59
	Glucose	3.50
September 29 [1]	Cane sugar	8.60
	Glucose	3.50
September 29 [1]	Cane sugar	8.61
	Glucose	3.44
October 3	Cane sugar	12 67
	Glucose	2.43

[1] This cane was lodged by storm.

From these we see that the cane sugar gradually and rapidly increased, while the glucose slowly decreased, from the time of flowering to the maturity of the seed. During the latter part of September, most of the cane was lodged by a very violent wind and rain storm. The juice from the stalks that were lodged was charged with a red coloring matter, the inside of the entire stalk being in many cases of a bright red color. Several of the stalks contained but a small portion of red coloring matter, but instead had a peculiar yellow and watery appearance, and quite a disagreeable taste. The juices from these contained on an average only 8 per cent. sugar, and 4.8 per cent. glucose.

EFFECT OF LEAVING CANE CUT IN THE FIELD.

A number of stalks still in good condition, the juice of which contained 9.50 cane sugar and 3.25 glucose, were cut and left in the field ten days, during almost constant rain. At the end of the ten days the juice contained 5.98 cane sugar and 6.15 glucose. Some Early Orange cane was also cut September 20, when the juice contained 10.50 cane sugar and 4.95 glucose, and was left in the field till November 2, when the juice contained 13.80 glucose, while not a trace of cane sugar was present. These experiments show conclusively that if cane is cut or injured and left exposed to rain, the destruction of cane sugar goes on very rapidly, being in time entirely changed into glucose. The rapidity of the change depends, of course, in great degree on the weather.

EFFECT OF LEAVING CANE CUT, UNDER SHELTER.

In order to ascertain the effect of leaving cane under cover, two tons of Early Amber cane were cut, the juice containing 10.02 per cent. of cane sugar and 3.23 per cent. of glucose. One-half was topped and stripped and both lots were placed on the floor of the barn. The change taking place may be seen from the following table:

	Cane sugar.	Glucose.
SEPTEMBER 20.		
The cane freshly cut	10.02	3.23
OCTOBER 4.		
After two weeks:		
(Stripped)	8.25	6.21
(Unstripped)	8.17	6.00
OCTOBER 19.		
After four weeks:		
(Stripped)	7.41	3.41
(Unstripped)	7.64	3.74
NOVEMBER 2.		
After 6 weeks:		
(Stripped)	8.26	3.74
DECEMBER 20.		
After 13 weeks:		
(Stripped)	8.45	6.80

To judge by the table the cane changes very slowly, but in reality the loss of sugar is quite rapid. If no loss of sugar took place, the juice would of course become richer in sugar, on account of the evaporation of part of the water. In reality this is not the case. The cane sugar becomes gradually changed to glucose, which in turn is destroyed by fermentation. In this way the juice may become even richer in sugar, but the quantity of juice is greatly diminished. The juice becomes also very acid. The effect produced by shocking the cane in the field was tried, with very unsatisfactory results, the cane sugar being destroyed very rapidly.

EFFECT OF LEAVING CANE STRIPPED IN THE FIELD.

One part of a patch of Minnesota Early Amber cane was stripped of leaves and left standing in the field from September 15 to September 22. It was then cut, and the juice, together with some that had not been stripped, was analyzed, with the following result:

	Cane sugar.	Glucose.
Cane stripped for one week	11.05	3.25
Same cane not stripped	12.98	2.78

The diminution of sugar is undoubtedly due to the fact that the latent leaf buds found under each leaf begin to develop into new leaves. These new leaves are formed partly at the expense of the sugar in the cane.

DEFECATION.

The juice after it leaves the mill has a more or less green color, due to the presence of large quantities of chlorophyl and other vegetable substances, which must be removed. This process is known as defecation. The defecator, or the vessel in which this operation is conducted, may be of wood. Copper is perhaps the best material, but is much more expensive. The vessel should be furnished with a steam coil, with sufficient capacity to heat the juice to the boiling point in a short time. As soon as the juice is expressed it should be removed to the defecator, where it should be heated at once to about 175° F., or just about hot enough to enable a man to hold his hand in the juice without being scalded. Milk of lime, freed from all coarse particles by straining, should then be added until a slip of red litmus paper becomes changed to a faint purple when dipped into the juice. The lime should be added in small portions, the juice being vigorously stirred with a paddle after each addition. When the right quantity has been added, the juice must be heated as quickly as possible. A thick green scum will soon come to the surface. When the boiling

point is reached,— which is shown by the swelling and breaking up of the scum,—the heat should be stopped and the juice left quiet for about five minutes. The scum will then be quite hard, and may be easily removed from the surface of the clear liquid. Much will depend on a good defecation. If the defecation has been properly conducted, the liquid will be clear, free from particles, and of a pale yellow color. If the scum is of a light color and thin, while the liquid below is opaque and has a greenish color, it shows that too little lime has been added; while if the juice is very dark, too much lime has been used. Much nicety of judgment is required to make a good defecation, which can only be obtained by experience.

USE OF SULPHUROUS ACID.

The clear juice from the defecator is now tolerably pure, most of the impurities having been eliminated. It contains, however, considerable lime, which if allowed to remain will give us a dark syrup, and if present in sufficient quantities will impart a more or less bitter taste to the syrup. To avoid this we must neutralize the lime, just as before we neutralized the acid. For this purpose sulphurous acid is much used. This acid may be added to the juice in the defecator after removing the scum, or it may be added to the juice in the evaporating pan. A sufficient quantity should be added to give to the juice a distinct acid reaction, or until a slip of blue litmus paper, dipped into the juice, is reddened. To accomplish the same result, many preparations have been sold to the farmers and other syrup manufacturers by agents and peddlers. I would here advise every one to leave all such preparations alone. Most of them are either harmful or good for nothing, while others are but modifications of the methods which I have described and for which the buyer pays an exorbitant price. As long as I remain at the university inquiries as to any method will be answered. Before closing this report we will describe methods by which sulphurous acid may be made at syrup works.

BOILING TO SYRUP.

The juice should be boiled down as rapidly as possible, the scum which comes to the surface being skimmed off. If con-

ducted entirely in an open train, it should be concentrated till it boils at about 234° F., which corresponds to about 45° B. If a vacuum pan is used, the syrup should be transferred to it when it has a density of about 20° B. It should then be concentrated to about 44° B, at as low a temperature and as quickly as possible. If the syrup is made too thick, the crystals of sugar will be small and difficult to separate; while if too thin the crystallization will take place very slowly. After the syrup has been boiled down to the proper density, it should be placed in a room where the temperature may be maintained at about 90° F. to crystallize. The crystallization usually begins in a few hours, and in five or six days the sugar may be separated. The syrup may be boiled down a second time, and a second crop of crystals equal to about one-half the quantity of the first may be obtained in a couple of weeks. A good yield of sugar may be obtained if the following rules are strictly adhered to:

1. Do not cut the cane until the seed begins to harden.
2. Do not allow the cane to stand stripped in the field.
3. Work up the cane as soon as possible after being cut.
4. Defecate the juice as soon as possible after leaving the mill.
5. For defecation use milk of lime, freed from coarse particles by straining; add it gradually to the juice with vigorous stirring, until a piece of red litmus paper is turned to a pale purple.
6. Heat the juice quickly to the boiling point, as shown by the swelling and breaking of the scum.
7. Remove the scum after allowing the juice to remain quiet for five minutes.
8. Draw off the clear juice, through an aperture near the bottom of the defacator, into the evaporating pan.
9. Add sulphurous acid to the clear juice until a piece of blue litmus paper is reddened.[1]
10. Evaporate down until it reaches a density of 45° B., or if boiled in an open pan, to a boiling temperature of 234° F.
11. Place in a warm room to crystallize, and in about a week it will be ready to separate.

[1] This step may be omitted if no excess of lime has been added during defecation. It will have no effect on the quantity of sugar obtained, but will make a lighter colored molasses.

RESULTS.

Below will be found a table containing the summary of the results obtained from two plots. Plot A was planted with seed obtained from Mr. Seth Kinney, of Morristown, Minnesota. Plot B was planted with seed from Mr. Charles Eustis, of Fort Atkinson, Wisconsin. Plot A was very much exposed and a great deal of the cane was lodged, while Plot B was more sheltered and the cane was in better condition.

	Field of plot A.	Field of one acre at the same rate as plot A.	Field of plot B.	Field of one acre at the same rate as plot B.
Area of plots in acres	$\frac{2}{13}$	....		....
Total weight of cane	4,669	30,348	4,710	23,550
Total weight of juice in cane	3,875	25,187	3,909	19,545
Weight of juice expressed	2,680	17,420	2,732	13,660
Weight of juice left in bagasse	1,195	7,767	1,177	5,885
Per cent. of cane sugar in juice	9.24	....	10.53	....
Per cent. of glucose in juice	3.53	....	2.68	....
Total weight of cane sugar in cane	358	2,327	415	2,075
Weight of cane sugar in expressed juice	248	1,612	290	1,450
Weight of cane sugar in bagasse	110	715	125	625
Weight of syrup obtained	332	2,158	408	2,040
Weight of cane sugar separated	142	923	199½	997½
Weight of molasses	190	1,235	208½	1,042½
Bushels of seed	....	27½	....	32

A glance at the table will show at once the wastefulness of the present mode of extracting the juice. Out of 85 per cent. in the cane, only 60 per cent. was obtained, or nearly 30 per cent. of the sugar in the cane was left in the bagasse. This loss is un-undoubtedly smaller than that sustained in the majority of cases, as 60 per cent. of juice is larger than the average per cent. obtained by the small mills usually employed. The absurd theory that if too much juice is expressed, it will cause the whole to "sour," make a poor syrup, etc., is entirely false.

THE DIFFUSION PROCESS.

The diffusion process for extracting the sugar from both beets and cane is now employed in nearly all of the principal factories. The cane is cut into thin slices by rapidly revolving cutting ma-

chines, the sugar being extracted from these by the use of water. If the pieces of cane are placed in a vessel, and a quantity of water equal to the quantity of juice in them be added, part of the sugar will at once pass through the cell walls into the surrounding water, while part of the water will enter the cells. This will continue until the liquids inside and outside of the cell walls are of the same density. If this water be drained off, it will contain half the sugar. If, now, this same cane be treated with equal and successive portions of water, each portion, when drained off, will contain one-half of the sugar contained in the cane at the time when it was added. In other words, the cane will retain after each draining, one-half, one-fourth, one-eighth, one-sixteenth, one-thirty-second, etc., of the sugar originally in the cane. In practice this process is carried on in such a way that the water is used over again on successive portions of cane until it becomes nearly as rich in sugar as the juice, only about 20 per cent. of water being added. An apparatus working on this principle has been invented in Europe, in which slices of cane or beets are made to pass upward through a cylinder, by the aid of a mechanical feeder, while water passes in at the top of the cylinder, and in passing down becomes more and more charged with sugar, until it issues from below, carrying with it almost the whole of the sugar from the cane.

In this way, it is claimed 94 per cent. of all the sugar in the cane is obtained, or 24 per cent. more than that obtained by an average good mill. This difference would constitute an immense profit in a large establishment. The juice is, moreover, perfectly clear, containing but small quantities of chlorophyl and other vegetable matter, which occur so abundantly in juice expressed by the mill. A better syrup and a larger yield of sugar is the result.

CANE FOR SYRUP MAKING.

For the making of syrup exclusively, some experiments were made with the Early Amber, Early Orange and Honduras. Three plots were planted, one with each variety, in close proximity to each other. They received the same amount of cultivation, and the comparative results are, we believe, as fair as they can possi-

bly be made. The plots were each one-fifth of an acre; and for convenience sake, the results in the following table are calculated to one acre:

	Early Amber.	Early Orange.	Honduras.
Weight of stripped stalks	23,520	31,000	42,330
Weight of juice expressed	13,660	17,966	24,433
Per cent. of juice expressed	58.80	57.95	57.70
Degree Beaume of juice	8.0	8.5	7.0
Per cent. of cane sugar in juice	10.63	10.50	7.00
Per cent. of glucose in juice	2.68	4.95	4.20
Gallons of syrup obtained	180	239	265

There was no marked difference in the quality of these different kinds of syrup, and it would certainly repay the cane growers to try the Honduras as a syrup producing cane. One great obstacle, however, is that the seed would have to be imported from more southern localities every season, as the seed hardly reaches beyond the milk stage before frost may be expected.

METHODS FOR MAKING SYRUP.

Several different methods for making syrup were used. The lightest colored syrup will be produced when the juice is nearly boiled down, and skimmed without defecation. The acids which in that case remain free in the syrup, change large quantities of the cane sugar to glucose, and impart the "sorghum taste" to the syrup. In order to make a syrup free from this taste, the juice must be defecated. The defecation should be conducted in the same manner as that described under sugar making. If too much lime is added, a dark syrup will be the result. If the lime is added very carefully, so as to make the juice very nearly neutral, an excellent syrup will be produced. The following rule for defecating juice for syrup works well: Fill the defecator three-fourths full with fresh juice; heat to about 160° F., and add milk of lime perfectly freed from coarse particles, until the juice becomes slightly alkaline. Fill the defecator with fresh juice, mix well and heat to boiling, skim and boil down to a syrup. The defe-

cation may also be carried out as described under sugar making, a quantity of sulphurous acid being added to the defecated juice until it becomes slightly acid. If properly conducted, this process will always make a good syrup. It is probably to be preferred to any other, as it is very easily performed. Not much care is requisite, as any small excess of sulphurous acid which has been added, will escape with the steam during the boiling down of the juice. Sulphate of aluminum may be used instead of sulphurous acid, with equally good results, but more care is necessary, since any excess that is added will remain in the syrup The flavor of the syrup will depend to a very great extent on the quantity of lime used for defecation, and the quantity to be added must be ascertained by practice. If the maker finds that the syrup still retains some of the "sorghum taste," it is a proof that too little lime has been used, and a stronger defecation should be made. If, on the other hand, the syrup is very dark, too much lime has been added.

CONSUMPTION AND PRODUCTION.

According to the late commissioner of agriculture a total of 2,000,000,000 pounds of sugar was consumed in the United States during the year 1879. "Of this amount 1,743,560,000, or more than 80 per cent., besides 38,395,575 gallons of molasses, were imported. The whole valued at $114,516,745." He says further: "To bring the vast amount of sugar imported into this country within more easy comprehension, we have only to imagine five vessels of nearly 500 tons each and loaded with sugar, arriving at our ports each day in the year." The question, therefore, can cane sugar be profitably manufactured from northern sugar cane, is one of immense importance to this country. That there is much prejudice to be overcome, is evident. There are men to whom the bare idea seems ridiculous. In the face of these difficulties, however, we venture to state that if skillfully conducted, the manufacture of sugar from this cane will certainly pay. Assuming the sugar to be worth 8 cents per pound, and the molasses 30 cents per gallon, we have the value of the produce per acre as follows:

Yield at the rate of plot A:

923 pounds of sugar at 8 cents	$73 84
103 gallons of syrup at 30 cents	30 90
Total	$104 74

Yield at the rate of plot B:

997½ pounds of sugar at 8 cents	$79 80
87 gallons of syrup at 30 cents	26 10
Total	$105 90

The seed has a composition about the same as corn, and will undoubtedly constitute a good food for farm animals. The utilization of the by-products will constitute another source of income. The first scums being very rich in nitrogen and mineral salts, will make an excellent fertilizer, and from the last scums, being rich in sugar, a good vinegar may be manufactured. Taking also into consideration that my experiments were conducted on a small and consequently a wasteful scale, my results are undoubtedly too low. If the capital is sufficient to produce both refined sugar and syrup, the value of the products will be increased by at least one-third.

COST OF PRODUCTION.

The cost of production is of course the main consideration, and although I cannot as yet give any definite figures, I am confident that after paying all costs a good profit may be realized. The best plan for conducting this industry will be to have large central factories. During the working season these factories can work up a large quantity of cane grown in their vicinity, and during the remainder of the year the crude produce from smaller establishments may be worked up and refined.

SUCRATE OF LIME PROCESS.

The sucrate of lime process now in full operation in Europe seems to be eminently fitted for carrying out this plan. A very brief outline of the process will perhaps not be out of place here. Sucrate of lime is a solid, containing when dry about 70 per cent. of sugar, and having the appearance of sand. It is insoluble in cold water, but soluble in hot water, and also in solu-

tions of sugar, not too concentrated. It is entirely unfermentable, and will not become mouldy or undergo decomposition, if kept for an indefinite length of time. It is therefore an excellent material for shipping and storing. Sucrate of lime may be manufactured on the farm with a comparatively small outlay. The juice is defecated as usual, and boiled down to from 30°–32° B. The syrup is then cooled and transferred to the sucration vessel. This vessel is usually made of galvanized sheet iron. In the center is a vertical shaft, carrying paddles. A certain quantity of pure and finely pulverized lime is then added, which becomes thoroughly mixed with the syrup by the motion of the paddles. The lime and sugar quickly combine, forming the sucrate of lime, which, when washed with cold water and dried, is ready for shipment to the refinery, where the sugar is separated from the lime and refined. This is, very briefly told, the process which we believe can be successfully applied to the manufacture of sugar from the sorghum cane. We trust that by another year, if these experiments are allowed to continue, some practical results in connection with this and the diffusion process may be brought out. It would have been very desirable to have made some experiments with these processes during the past season, but our time was entirely taken up by the work which has been done. Moreover, the limited amount of means at hand would not warrant the construction of the special machinery necessary for conducting these processes.

PRODUCTION OF SULPHUROUS ACID.

Considerable quantities of sulphurous acid are needed in making syrup, and much expense may be saved by making it at the factory. When sulphur is burnt in the air, each part of sulphur unites with two parts of oxygen from the atmosphere, forming a gas called sulphur dioxide. This gas is readily soluble in water.

When water has a temperature of 50° F. it will absorb 50 volumes, or one gallon of water will absorb 50 gallons of the gas. As the temperature of the water rises, it becomes less capable of absorbing the gas, so that at 70° F. it will absorb only 34 volumes. The solution of this gas in water constitutes sulphurous acid.

Hence to prepare it, all that is necessary is to cause the fumes of burning sulphur to come into contact with water.

The easiest way for persons using steam-power to make this acid is to draw the fumes of burning sulphur from the furnace by a common gas pump and force them through a pipe reaching to the bottom of a barrel filled with water. The bubbles of gas escaping through the lower end of the pipe will be absorbed by the water in ascending. It is best to bend the pipe so that its lower end may lie along the bottom of the barrel. The open end should be closed, and the part lying on the bottom should be pierced with small holes so as to make a large number of small bubbles, instead of a few large ones, the gas being absorbed in this manner more rapidly. In this way a barrel of sulphurous acid may be made at a cost of from 75 cents to 80 cents. Any further information may be obtained on this subject by writing.

Below will be found the analysis of several bundles of cane, which I received from different parts of the state. Many bundles arrived without any labels, having lost them during transportation. Such samples were not analyzed, as it was impossible to tell whence they had been sent. If parties who have sent cane are not represented in the following table, it is because I have received no information in regard to the cane sent, or else the cane has been without labels, making it impossible for me to tell where it belonged.

ANALYSES.

Name of sender.	Name of grower.	Locality.	Character of soil.	Time of planting.	Date of cutting.	No. of stalks.	Weight of stalks.	Per cent. of juice expressed.	Per cent. of cane sugar in juice.	Per cent. of glucose in juice.	Time of analysis.	Variety.
A. C. Kent	....	Janesville	Sandy loam	May 15.	Oct. 5	12	18	48.0	7.29	3.94	Oct. 8	Early Orange.
A. C. Kent	....	Janesville	Sandy loam	May 20.	Oct. 5	12	12½	60.0	11.14	3.40	Oct. 8	Early Amber.
Wm. Toole	Alex Toole	North Freedom	Clayey	....	....	12	8	53.1	6.50	5.45	Oct. 10	Early variety.
Wm. Toole	John Leiler	North Freedom	Clayey	May 15.	Oct. 6	13	10¾	58.8	9.92	2.96	Oct. 10	Early Amber.
Wm. Toole	Henry Rhe	North Freedom	Clay loam	June 23.	Oct. 5	12	10¾	62.8	6.25	5.12	Oct. 10	Early Amber.
Caspar Eberdt	C. Eberdt	Tomah	Sandy loam	May 26.	Sept. 6	12	12½	52.0	12.83	2.94	Oct. 10	Early Amber.
Caspar Eberdt	Griggs	Tomah	....	....	....	5	6¾	55.5	10.94	3.59	Oct. 11	Early Amber.
Caspar Eberdt	Lene Sweet	Tomah	Heavy clay loam	May 15.	....	12	10¾	55.8	4.88	5.23	Oct. 11	Early Amber.
Caspar Eberdt	Forrest	Tomah	....	....	....	12	9¾	59.0	8.98	3.45	Oct. 11	Early Amber.
Caspar Eberdt	Faukner	Tomah	Sandy loam	May 20.	....	12	12½	56.0	7.01	4.50	Oct. 11	Early Amber.
Caspar Eberdt	Prescott	Tomah	....	....	....	5	5½	50.0	6.77	5.78	Oct. 11	Early Amber.
Caspar Eberdt	Stevens	Tomah	....	....	....	11	13	61.5	7.08	5.36	Oct. 11	Early Amber.
L. B. Green	L. B. Green	Hebron	Light loam	May 15.	Oct. 10	12	12	52.0	13.11	3.22	Oct. 12	Early Amber.
L. B. Green	L. B. Green	Hebron	Light loam	May 12.	Oct. 10	12	11¾	51.1	13.63	2.65	Oct. 12	Early Amber.
B. C. Dinsdale	J. Monteith	Preston	Black loam	May 26.	Oct. 6	12	15½	56.4	10.87	2.59	Oct. 12	Early Amber.
B. C. Dinsdale	Geo. Whitish	Preston	Clay	May 26.	Oct. 6	12	8	51.3	6.00	8.43	Oct. 12	Early Amber.
B. C. Dinsdale	B. C. Dinsdale	Preston	Prairie loam	June 3.	Oct. 6	12	12	58.3	6.23	7.56	Oct. 12	Early Amber.
E. W. Sanders	E. W. Sanders	Oshkosh	Sandy loam	June 1.	Oct. 12	12	7¾	58.1	6.21	3.98	Oct. 14	Early Amber.
J. W. Baily	J. W. Baily	Ripon	Clay land	May 5.	Oct. 12	12	14	60.7	7.61	4.50	Oct. 14	Early Amber.
J. W. Baily	J. W. Baily	Ripon	Clay land	June 1.	Oct. 12	12	8¾	54.3	6.59	3.96	Oct. 14	Early Amber.
J. M. Nash	J. M. Nash	Hudson	Sandy loam	May 10.	Sept. 24	12	11	63.6	10.31	6.02	Oct. 14	Early Amber.
J. M. Nash	J. Dailey	Hudson	Black loam	May 16.	Sept. 28	12	11½	71.7	4.70	5.4[illegible]	Oct. 14	Early Amber.
J. M. Nash	E. L. Nash	Hudson	Very sandy	May 12.	Sept. 26	13	11¼	66.6	9.07	5.36	Oct. 14	Early Orange.
J. M. Nash	J. W. Nash	Hudson	Sandy loam	May 25.	Oct. 5	12	13	57.7	4.50	9.50	Oct. 14	Stewart's Hybrid.
R. L. Clason	R. L. Clason	Beaver Dam	Clay	May 12.	Oct. 8	12	6¾	51.8	8.70	8.20	Oct. 21	Golden Imphee.
R. L. Clason	C. Driseil	Beaver Dam	Wash of barnyard	May 21.	Oct. 11	6	4¼	58.8	5.77	5.60	Oct. 21	Early Amber.
R. L. Clason	H. Lowell	Beaver Dam	Clay	May 15.	Oct. 2	9	5	55.5	8.78	5.62	Oct. 21	Early Amber.
A. J. Decker	A. J. Decker	Fond du Lac	....	....	....	12	14½	51.7	6.73	6.90	Nov. 2	Kansas Orange.
A. J. Decker	A. J. Decker	Fond du Lac	Clay soil	May 20.	Sept. 10	12	11½	58.7	6.43	5.52	Nov. 2	Early Amber.
A. J. Decker	A. J. Decker	Fond du Lac	Black soil	May 20.	Sept. 10	12	15¾	49.0	7.15	6.85	Nov. 2	Early Amber.

It is hardly possible to draw any definite conclusions from the above analyses, as many samples were not received for several weeks after being cut. It will be seen, however, that nearly all those samples which were analyzed within but a few days after being cut contain a large proportion of cane sugar, while those which were analyzed after a longer period of time show a high content of glucose, and a low proportion of cane sugar. This corroborates my statement in the first part of this report, and shows the necessity of working up the cane directly from the field in order to get the best results.

It will also be seen that all the samples conspicuous for their high content of cane sugar are raised on a light soil, usually sandy loam, while those raised on heavy clay land contain large proportions of glucose. It therefore appears that in order to obtain a maximum content of cane sugar, the cane should be grown on a light soil. For making syrup alone, the cane raised on clayey land will do about as well, as the high content of glucose will not materially affect the quality of the syrup.

VARIETIES OF CANE GROWN FOR EXPERIMENTS.

By Prof. W. A. Henry.

Amber cane was grown from seed obtained from Charles Eustis, Fort Atkinson, Wisconsin, and Seth Kinney, Morristown, Minnesota. From Mr. Kinney were also several packages of seed of Early Amber grown under different conditions. From J. A. Hedges, St. Louis, Missouri, Kansas Orange, Hedges' Early Orange, Early Orange and Honduras. Also Early Orange from Illinois Industrial University, Champaign, Illinois, through Prof. M. A. Scoville.

All these varieties and sub-varieties showed peculiarities worthy of attention, but it is useless to report from one season only.

The experiments this year all centered about the question of how much sugar and syrup could be obtained from the cane, and in this Mr. Swenson's attention was so absorbed that the relative merits of each of the varieties could not be investigated.

A thick or thin stand of cane evidently makes a great difference in the quality of the juice, and a fair test of varieties can only be made when each has been planted in various ways as to width of rows, distance apart of hills and number of stalks in the hill.

There is no doubt but that varieties vary in value, and it is important that the peculiarities of each be known, yet it is a more difficult task to find this out than with most farm crops. If the experiments are continued next season, this will be one of the problems to work upon.

AMOUNT OF SYRUP PRODUCED PER ACRE.

As might be expected, the reports show a wide variation in the amount of syrup which is obtained from an acre of ground. Not only does the difference follow from variations in quantity and quality of cane produced, but also from varying densities to which the syrup is reduced. Some manufacturers make a much thicker syrup than others. The reported yields therefore show

only in an imperfect way what can be obtained; still they are of value, I think, to those looking up the subject.

S. Hanson, of Whitewater, one of the oldest and most experienced growers in the state, reports 18 gallons from ten rods of ground and 200 gallons per acre from larger pieces.

Joseph H. Osborn, Oshkosh, reports the highest yield, 226 gallons, with an average of 150.

N. D. Comstock, Arcadia, Trempealeau county, estimates the average at 125 gallons.

Maxon and Almony, Milton Junction, Rock county, estimate the average at 150 gallons.

J. H. Rhodes, Sextonville, Richland county, raised on one acre 170 gallons.

O. S. Powell, of River Falls, Pierce county, estimates the average crop at 100 gallons.

H. T. Webster, Keene, Portage county, obtained 40 gallons from twenty-eight rods of ground.

J. D. Sherwood, Dartford, Green Lake county, reports one-third of an acre yielding 12,588 pounds of stalks, from which 79.14 gallons of syrup were made.

A. J. Decker, Fond du Lac, considers 125 gallons the average.

Mr. S. Nason, of Nasonville, Wood county, where cane was grown this season for the first time, reports 800 gallons from four acres.

Evan Erickson, Stevenstown, La Crosse county, obtained 1,050 gallons from five acres.

The average yield of syrup on good ground in a favorable season may be set down at about 160 gallons. With such culture as is usually given to it the yield will be about 100. It may be set down as a fact that wherever it has been planted in the state, it has succeeded no matter how poor the soil was. It promises to be one of the very best crops for our sandy lands, for though the yield per acre will not be large, the syrup will be of fine quality. Land on the experimental farm which produced fifty bushels of corn per acre this year gave two hundred gallons of thick syrup.

TONS OF CANE PRODUCED PER ACRE.

This season several of the large manufacturers have purchased cane by the ton, the price paid usually being $2.50 per ton for stripped and topped cane delivered at the mill. This makes it important to ascertain the number of tons produced per acre.

I take the following yields from the same source as before:

N. D. Comstock, Arcadia, Trempealeau county, grew fifteen tons, yielding 171 gallons, on one acre.

Geo. Grant, Janesville, reports one instance of eleven tons grown on an acre, producing fourteen gallons of syrup per ton, each gallon weighing eleven and a half pounds. A. C. Kent, Janesville, puts the average product for the year at ten tons per acre. The average may be safely stated at from ten to twelve tons per acre, according to the soil and season, I think. Should the industry grow in importance, purchasing cane by weight from the grower will become a very common practice, and if we may judge from the difficulties arising between beet growers and sugar manufacturers in France, it is easy to see that no small amount of trouble will occur with us.

To purchase cane simply by weight, without regard to its character, will be alike ruinous to manufacturer and grower. In some way the quality of the juice must be considered. For syrup making, a densimeter, as the Baume scale, will do fairly well in helping determine the true value of cane. In the standard ton of cane the stalks should be straight, with leaves and top removed, all small canes and suckers being left out. The juice should have a certain density, as shown by the Baume scale.

The price for such cane could be agreed upon by growers and manufacturers before planting time. At the same time the price of cane which falls below this standard or rises above it, can also be arranged.

Those who are contemplating this business on a large scale cannot turn their attention to this part of the industry any too soon, for our farmers are too independent of any one crop to attempt raising Amber cane for syrup boilers who are so careless that they will not pay for what they get according to its true value. Great care must be exercised to make the business a profitable one for

careful growers. By purchasing according to a standard, the grower who plants upon sandy land, for instance, and produces a very high grade cane, may find the small number of tons from an acre returning a good profit, while a stated price per ton, without regard to quality, would drive him from the business.

It may be interesting to note in this connection that in France the price is $4 for a ton (2,200 pounds) of beets, the juice of which has a density of 5.5 degrees (1.055), and that for variation above or below this standard, special contracts are usually made, though in general where the system has been adopted, 80 cents is added to this price for each additional degree above the standard, and subtracted for each degree below.

CANE SEED FOR FEED.

For several reasons the value of cane seed for feed has received little attention. Its importance has not yet impressed itself upon cane growers. As will be seen from Mr. Swenson's report, from one-fifth of an acre of ground, 6⅔ bushels of seed, weighing 53 pounds per bushel, were obtained, or at the rate of 32 bushels per acre.

The average yield of oats in the vicinity of Madison this season was about 35 bushels.

J. M. Edwards, Oak Hill, Jefferson county, reports 230 bushels of seed, weighing 58 pounds per bushel, from 9 acres.

I do not think the feeding value of this seed can fall below that of oats, and possibly it is nearly equal to corn. Experiments will be tried upon the farm this winter to learn its value by practical tests.

There is no difficulty in saving the seed, as the heads can lie upon the ground a long time unless there is an excessive amount of rain. The heads can be drawn and spread on the barn floor, or what would be better, arranged on racks in a shed like broom corn. Some bind the heads in bundles and stand them on end in the field like bundles of wheat, to dry.

According to one test the weight of the green leaves as stripped from the cane is nearly one-fourth as much as the weight of the stripped cane. From this I estimate that an acre producing, for instance, twelve tons of stripped cane will yield three tons of

green leaves, which will afford somewhere between half a ton and a ton of dried leaves per acre.

All who have fed these dried leaves speak of them as equal to hay in value; they are not difficult to dry or care for, but owing to the season of the year and the great press of work at that time, they are apt to be neglected. The unusual rainy fall made it impossible to save the leaves from our cane for experimental feeding, as had been intended.

THE LESSONS OF THE SEASON.

As a summary of the reports sent in by one hundred and eighty manufacturers, I would state that the season, upon the whole, cannot be called a favorable one. Probably owing to the intense cold that came on in November, 1880, the vitality of cane seed was so injured that when planted last spring it failed in many instances to grow. This cut down the acreage very considerably in many localities. The fall frosts were long delayed, and in this regard the season was peculiarly favorable. The almost daily rains during the whole fall made stripping very disagreeable and the roads almost impassable, so that the cane could not be drawn far, and much of it spoiled in the fields. Again, heavy autumn winds laid the cane flat and tangled it, making the expense of stripping and cutting fully double what it should have been.

Mr. Swenson's analyses show that the cane sugar is mostly changed to glucose when the cane is blown down, though the loss is not so manifest when syrup alone is made. Had sugar been the object with our manufacturers this season, it would have been a very unfavorable one.

This year has seen the introduction of steam into quite a number of factories, by which means syrup can be made much cheaper than by direct heat. With such facilities defecation is easily practiced, and syrup of superior quality made. I consider the success attained by these steam boiling works as the most marked event of the season. Previous to this year no one had but a few hundred dollars invested in the business. There seemed to be no chance for capital to take hold of it as long as direct heat was used, but with the introduction of steam apparatus, capital can be invested with profit to the owner and advancement to the busi-

ness. With so many large manufacturers in the field, Amber syrup must go into the market in considerable quantities, and this, with the high quality of the goods, will soon command public attention. It is the introduction of these large factories that we must expect and encourage, if this is to become one of the great industries of the state.

One of the plainest lessons of the season is the importance of growing cane close to where it is worked up. A wagon load of the stripped stalks at the crusher is not worth over five dollars.

It at once becomes evident that such weighty material cannot be drawn long distances with any profit, and that the syrup works must be located near the fields where the cane is grown. Cane to be profitable should not be grown over two miles from the works, unless the roads are excellent, when possibly three may be set as the limit. Those who are locating mills should aim to settle at points where the cane fields can be about them on all sides. Fuel need not be considered, for the bagasse is sufficient when properly managed to supply all the heat needed. The transportation of the syrup requires that the works be near a railroad station.

Another fact of the utmost importance has been made plain this season, that is, defecation of the juice by some method is essential. The prejudice against the syrup because of its acid or "sorghum taste" keeps the market price down below what it should be, and then buyers will only take it at a low price or not at all. If they must pay syrup prices, they prefer New Orleans.

Even the syrup shipped is not sold to the consumer direct, but is first mixed with glucose to remove the strong taste, or rather to flavor the glucose.

The only way to overcome this prejudice is to make a syrup with the sorghum taste left out. The experiments on the farm and by others show this to be possible, and that the methods are, upon the whole, very simple. I am aware that quite a prejudice exists among boilers against any clarification of the juice. Some even argue that people refuse to purchase Amber cane syrup not because of its sorghum taste, but because it is a home product. They forget that maple syrup, a home product, brings three times the price of the New Orleans.

Our boilers here exerted every effort toward making a light

colored syrup, and because lime darkens it they are afraid to use lime. If every boiler would use lime cautiously next season, letting color be considered after flavor, there would be more real advancement in the industry than ten years of present methods of attempted improvement will bring. At present, less than ten per cent. of the boilers use lime or practice defecation of any kind.

CAN THE FARMER MAKE HIS OWN SUGAR?

This is a question naturally asked by many who have not studied the problem to any extent.

Most certainly not, if profit is to be considered. A farmer might have a mill and make his own patent process flour, but it would not pay him. His business is rather to grow the wheat, while skilled men attend to the milling.

While first class Amber syrup can be made by proper means with a small investment and a fair amount of skill, sugar making must be left to skilled men under the direction of a chemist or expert. Such experts must be trained to work with northern cane, and not brought from southern localities where the conditions are very different. Such persons though experts at home would only be students, for a time at least, at the north. In order to manufacture sugar there must be quite a large investment of capital in machinery; to manage this there must be skilled men, and over all must be a man who by chemical tests reads the varying conditions of the juice as it runs from the crusher from day to day, and whose work is law with all other employees. Until there are such experts capital should be most cautious. Fine sugar works with costly machinery will not alone bring sugar, as the many past failures show. It would be far better for all concerned to wait ten years before another step is taken in this promising industry than to have it blighted in the start by failures. With capital carefully invested in proper machinery, the works located in the midst of cane fields, and run by good workmen and a skilled chemist, there is no doubt but money can be made as rapidly as in any manufacturing business. When success comes, the farmer will sell his cane at the sugar works as he does his wheat at the mill, but he will not be a sugar boiler and farmer combined.

EXPERIMENT WITH FERTILIZERS.

In order to ascertain the value of fertilizers in the production of syrup, an experiment was planned a year ago, in which the co-operation of our Wisconsin farmers was solicited. Over forty farmers agreed to carry out a simple experiment as I directed. The following are the directions which were sent to each in April last:

DIRECTIONS FOR THE EXPERIMENT.

Select in the field where cane is to be planted three plots of ground, each containing not less than ten square rods and lying side by side. The ground should be as uniform as possible in its composition and fertility. Do not select soil where one end of the plot is sand and the other loam or clay. No matter which it is, but have it all of one character. Have the plots, if possible, long and narrow, say one rod by ten, or two by twenty, etc. The plots should lie side by side and should not be separated from one another or the rest of the field. One plot, No. 1, plow in well-rotted stable manure at the rate of sixteen large loads per acre—one load for every ten rods. Plot No. 2, which is to be the middle plot, has no manure of any kind upon it. When the cane on plot No. 3 is three or four inches high apply plaster to the hills or rows to the amount of one hundred and sixty pounds per acre, or ten pounds for every ten rods. The cane is to be planted and cultivated in the same manner as the rest of the field. If possible, weigh the cane of each plot separately when ready for the mill. Boil the juice to a syrup weighing eleven and a half pounds per gallon, and determine accurately the yield of each plot. Save a sample of syrup from each plot for comparison.

Report to the department upon the following points:

1. Amount of ground in each plot.
2. Character of soil — clay, loam, sand, etc.
3. Is soil naturally rich or poor?
4. Number of years the field has been in cultivation.
5. Crops grown on field previous year.
6. Whether or not the field was manured the previous year.
7. Method of planting cane — in drills or hills.

8. Time of planting.
9. Time of ripening.
10. When manufactured.
11. Yield of syrup from each plot.
12. Character of syrup from each plot, as to color, clearness and flavor.

But one of all who agreed to undertake the experiment carried it through successfully. Mr. S. B. Chatfield, of Adams, Walworth county, makes the following report:

ADAMS, January 2, 1882.

MR. W. A. HENRY:

Dear Sir — I have been so very busy that I have neglected to send samples until to-day. I express them as you requested. I will answer those questions to the best of my ability:

No. 1. 1 rod wide, 10 rods long.
No. 2. Black sandy loam.
No. 3. Naturally rich.
No. 4. Under cultivation 33 years.
No. 5. Sugar cane.
No. 6. Not manured the previous year.
No. 7. In drills.
No. 8. Planted 19th of May.
No. 9. Ripe from 12th to 15th of September.
No. 10. Manufactured September 28.
No. 11. No. 1, 17 gallons; No. 2, 10 gallons; No. 3, 14 gallons.
No. 12. The three samples must speak for themselves.

The samples were indeed interesting. That from unmanured soil was light colored, and sugar crystals in considerable numbers and of fair size formed in it. The syrup from the manured plot was the darkest. Other qualities, marked in their way, I am very sorry I cannot report on, as Mr. Chatfield's samples were put on exhibition at the state cane growers' convention, and two of the bottles were carried off by some visitor.

It is most unfortunate that more had not been as persistent as Mr. Chatfield, for untold good would flow from united work in this way.

If there are any of our farmers who are willing to try such an experiment again, I shall be pleased to have their names and will forward directions in due time.

The importance of united work will appear plain to all who have grown cane to any extent.

LIST OF SYRUP MANUFACTURERS IN WISCONSIN.

The following is a list of all manufacturers whose names I have been able to obtain, together with address and amount of syrup made by each during the fall of 1881.

For convenience of reference, they are arranged alphabetically by counties:

Name.	Postoffice.	County.	Gallons syrup made in 1881.
George Cochran	Gilmanton	Buffalo	1,350
Edwin Blood	Stockbridge	Calumet	7,700
John B. Sweet	Chilton	Calumet	900
C. C. Carr	Poynette	Columbia	1,700
L. K. Goodall	Lodi	Columbia	320
Charles W. Peters	Columbus	Columbia	863
Cyrus Root	Otsego	Columbia	1,000
L. S. Wright	Fall River	Columbia	2,000
I. B. Hayden	Freeman	Crawford	1,000
Samuel A. Clark	Prairie du Chien	Crawford	1,000
W. J. Lankford	Ferryville	Crawford	800
C. R. Rounds	Mt. Sterling	Crawford	1,000
A. H. Anderson	Black Earth	Dane	1,200
J. H. Greening	Mazomanie	Dane	2,002
Henry Linley	Mazomanie	Dane	1,200
W. M. Sprague	Lake View	Dane	303
B. F. Williamson	Madison	Dane	1,350
R. L. Clason	Beaver Dam	Dodge	2,200
C. J. Davis	Beaver Dam	Dodge	853
Charles Link	Danville	Dodge	1,800
Joseph Philips	Randolf	Dodge	1,400
W. H. Clyde	Rock Falls	Dunn	2,000
W. H. Doane	Fall City	Dunn	800
H. J. Myers	Elk Mound	Dunn	1,878
F. M. Steves	Louisville	Dunn	4,100
W. W. Waterbury	Augusta	Eau Claire	2,600
George W. Jones	Fairchild	Eau Claire	800
J. W. Bailey	Ripon	Fond du Lac	3,000
A. J. Decker	Fond du Lac	Fond du Lac	10,000
C. J. Gordon	Oakfield	Fond du Lac	5,800
George Jenkinson	Brandon	Fond du Lac	2,500
M. M. Alexander	Montfort	Grant	550
C. D. Barnes	Brodtville	Grant	1,530
Francis A. Markert	Lancaster	Grant	125
Lewis Glass	Wyalusing	Grant	105
C. S. Ruddock	Berlin	Green Lake	1,500
G. W. Sheldon	Markesan	Green Lake	3,700
J. D. Sherwood	Dartford	Green Lake	4,877
Aug. Ziemer	Berlin	Green Lake	1,830
Peter Crook	Dodgeville	Iowa	900
J. P. Beard	Elroy	Juneau	650
F. W. Board	Elroy	Juneau	800
E. G. Dodge	Mauston	Juneau	2,400
Riley Moulton	New Lisbon	Juneau	1,500

NAME.	POSTOFFICE.	COUNTY.	Gallons syrup made in 1881.
D. Travis	Wonewoc	Juneau	662
A. L. White	Mauston	Juneau	2,800
Wm. Goudre	Milford	Jefferson	900
P. W. & C. S. Cartwright	Rome	Jefferson	2,500
F. E. Chartier	Rome	Jefferson	5,000
E. Colwell	Farmington	Jefferson	2,500
J. M. Edwards	Oak Hill	Jefferson	4,200
John Moore	Rome	Jefferson	4,200
R. S. Pearsall	Waterloo	Jefferson	2,000
L. B. Green	Hebron	Jefferson	1,600
Frank C. Lehman	Watertown	Jefferson	2,800
Williams & Colwell	Farmington	Jefferson	8,000
Williams & Dow	Palmyra	Jefferson	900
W. H. Peardon	Palmyra	Jefferson	2,000
William Jaudre	Palmyra	Jefferson	1,000
Smith Hoyt	Milford	Jefferson	2,500
Geo. B. Allen	Milford	Jefferson	100
H. C. Davis	Irving	Jackson	1,700
B. C. Henry	Pine Hill	Jackson	1,959
L. W. Thayer	Kenosha	Kenosha	1,564
James F. Petrie	Kenosha	Kenosha	400
Evan Erickson	Stevenstown	La Crosse	1,800
Nels Hanson	Rockland	La Crosse	600
N. D. Loomis	West Salem	La Crosse	3,500
T. O. Masher	Bangor	La Crosse	000
Hollister Phillips	Mindora	La Crosse	600
Henry Rhode	Barre Mills	La Crosse	1,000
H. H. Slye	Mindora	La Crosse	2,025
Frank Pfaff	Burr Oak	La Crosse	1,165
Riley T. Scott	Yellowstone	La Fayette	1,465
Vincent Bruner	Blanchardville	La Fayette	550
Richard Graham	Jeddo	Marquette	1,876
G. A. Scott	Westfield	Marquette	2,700
T. Wells	Neshkora	Marquette	1,700
L. Baring	Oil City	Monroe	666
Casper Eberdt	Tomah	Monroe	1,800
W. G. West	Sparta	Monroe	1,675
M. Shidle	Sparta	Monroe	2,000
Samuel Thompson	Osceola Mills	Polk	3,209
W. H. Tilton	Osceola Mills	Polk	1,084
J. McLean	St. Croix Falls	Polk	919
L. E. Buck	Sherman	Portage	1,000
W. M. Burrows	Almond	Portage	2,500
Silas D. Clark	Plover	Portage	2,130
Nicholas Piper	Almond	Portage	2,576
Albert Taylor	Blaine	Portage	2,630
Reuben Thompson	Amherst	Portage	2,353
H. T. Webster	Keene	Portage	1,500
Alex. G. Coffin	Durand	Pepin	1,969
A. H. Cott	Jeddo	Pepin	1,700
D. W. Phelps	Durand	Pepin	900
S. L. Plummer	Arkansaw	Pepin	3,400
Hiram B. Stone	Durand	Pepin	1,950

Name.	Postoffice.	County.	Gallons syrup made in 1881.
T. J. Atwater	Prescott	Pierce	2.000
O. S. Powell	River Falls	Pierce	10,500
L. L. Richardson	Clifton Mills	Pierce	2,0[illegible]0
Conrad We[illegible]horn	Ellsworth	Pierce	2,100
Charles N. Soule	Rochester	Racine	400
Thos. McFarland	Waterford	Racine	1,200
Nims & Voorhees	Burlington	Racine	1,6[illegible]
A. A. Cowey	Port Andrew	Richland	1,600
John J. Dillon	Basswood	Richland	1,000
R W. Peters	Basswood	Richland	1,942
J. H. R[illegible]des	Sextonville	Richland	269
N. G. S[illegible]rram	Basswood	Richland	500
Thos. S. Palmer	Eagle Corners	Richland	400
Buob & Rossell	Janesville	Rock	2,390
Conrad & Dibble	Evansville	Rock	2.000
George Grant	Janesville	Rock	2,100
A. C. Kent	Janesville	Rock	9,[illegible]00
M. M. Tullar	Evansville	Rock	630
W. J. McIntyre	Whitewater	Rock	2.500
Maxon & Almony	Milton Junction	Rock	6,0[illegible]0
Bauernfeind & Alletzan.	Glenbeulah	Sheboygan	4,000
M. J. Adams	Baraboo	Sauk	1,500
L. T. Allbe	North Freedom	Sauk	1,550
Isaac W. Carpenter	White Mound	Sauk	1,000
C. H. Dome	Baraboo	Sauk	1,140
G. F. Faller	Baraboo	Sauk	1,100
C. Henneberg	La Valle	Sauk	2.3[illegible]0
J. T. Huntington	Delton	Sauk	3,200
W. Jefry	Baraboo	Sauk	700
W. H. Koukel	Baraboo	Sauk	1,556
J. W. Shourds	Reedsburg	Sauk	1,100
C. R. Thayer	Baraboo	Sauk	1.410
R. F. Co[illegible]e	Reedsburg	Sauk	1,460
J. B. Filbian	Hammond	St. Croix	3,000
Foster & Nye	New Richmond	St. Croix	3,500
F. W. Hitchings	N. Wis. Junction	St. Croix	1,400
J. M. Nash	Hudson	St Croix	5,000
E. G. Partridge	Warren	St. Croix	3,200
N. D. Comstock	Arcadia	Trempealeau	2,000
B. Dissmore	Whitehall	Trempealeau	2,050
A. F. Heus[illegible]l	Arcadia	Trempealeau	450
A. H Rogers	Osseo	Trempealeau	1,765
D. S. Watson	Whitehall	Trempealeau	2.800
H. H. Morgan	Red Mound	Vernon	3,600
L. F. Day	Retreat	Vernon	1,200
W. Frazier	Enterprise	Vernon	2,300
E. B Hyde	Retreat	Vernon	900
M. K. Jefferies	Hillsboro	Vernon	225
C. Bloeman	Red Mound	Vernon	1,780
S. H. Helmer	Hartford	Washington	600
S. S. Nason	Nasonville	Wood	1,500
Henry Hall	Eureka	Winnebago	1,743
A. G. Lull	Oshkosh	Winnebago	600

Names.	Postoffice.	County.	Gallons syrup made in 1881.
Whitemarsh & Edwards	Oshkosh	Winnebago	2,000
Joseph H. Osborn	Oshkosh	Winnebago	3,500
W. M. Davies	Wild Rose	Waushara	1,150
Charles O. Dill	Oasis	Waushara	1,000
D. A. O. McGowan	Hamilton's Mills	Waushara	516
Wm. Scobie	Spring Lake	Waushara	1,600
H. C. Van Airsdale	Saxville	Waushara	1,000
W. M. Ware	Hancock	Waushara	777
Wilfred Lane	Wild Rose	Waushara	500
M. D. Morrison	Eagle	Waukesha	800
Romeo Sprague	Eagle	Waukesha	1,000
Edward P. Hinkley	Eagle	Waukesha	750
S. B. Chatfield	Adams	Walworth	1,606
T. M. Cook	Little Prairie	Walworth	1,150
S. Hanson	Whitewater	Walworth	2,000
Chas E. Horton	Whitewater	Walworth	100
J. Patchin	Heart Prairie	Walworth	1,100
Pliny Potter	Little Prairie	Walworth	250
T. M. Shoudy	Geneva	Walworth	400
Ambrose Warner	Whitewater	Walworth	2,300
Richard Chambers	Weyauwega	Waupaca	550
John Clark	Waupaca	Waupaca	2,000
W. E. Clark	Bear Creek	Waupaca	900
R J. Folks	Waupaca	Waupaca	2,300
E. G. Furlong	Rural	Waupaca	2,000
T. S. Neyward	Rural	Waupaca	1,800
Sumner Packard	Crystal Lake	Waupaca	1,000
Alvin Pope	Lind	Waupaca	3,000
J. Rode	Ogdensburg	Waupaca	400
Milton Stanley	Manawa	Waupaca	1,500

The following names have been received since tabulating the above:

NAMES.	POSTOFFICE.	COUNTY.	Gallons syrup made in 1881.
Silas Hammond	Strong's Prairie	Adams	330
M. P. Hammond	Strong's Prairie	Adams	900
D. McDonald	Verona	Dane	800
Cyrus G. Patton	Augusta	Eau Claire	1,300
Gustav Yiss	Otto Creek	Eau Claire	1,400
John R. Roth	Platteville	Grant	1,000
Charles E. Bowerman	Patch Grove	Grant	718
James F. Brown	Mineral Point	Iowa	1,100
J. E. Arnold	Melrose	Jackson	800
R. Grant	Necedah	Juneau	618¾
L. F. Crandall	North Bend	Jackson	3,470
Wm. Gaven	Mindora	La Crosse	2,700
Otto Amundson	Stevenstown	La Crosse	1,000
James Sykes	Stevenstown	La Crosse	1,100
John C. O'Bleness	Jeddo	Marquette	1,100
A. J. Cunningham	Woodstock	Richland	900
Travers & Snyder	Woodstock	Richland	1,500
Bennett & Mecum	Richland Center	Richland	800
Ole O. Lamb	Glasgow	Trempealeau	2,300
Alex. Cauce	Ettrick	Trempealeau	2,000
R. F. Gale	Reedsburg	Sauk	1,460
Charles Fuchs	Spring Green	Sauk	2,800
Jacob Mann	Spring Green	Sauk	500
Ole Kanteson	Spring Green	Sauk	500
William Stevenson	De Soto	Vernon	2,939
George C. Clark	Victory	Vernon	1,400
W. W. Minor	Retreat	Vernon	2,100
Joseph Morgan	Retreat	Vernon	1,800
S. M. Honaker	Liberty Pole	Vernon	2,000
Warren C. Bates	Retreat	Vernon	750
A. H. Bates	Retreat	Vernon	1,400
Lester N. Porter	Wautoma	Waushara	1,572

CORRESPONDENCE.

From among a large number of letters upon the subject, I select the following, which will, I am certain, be read with interest:

[From A. J. Decker, Esq., Fond du Lac, Wis.]

FOND DU LAC, WIS., December 17, 1881.

Prof. W. A. HENRY, Agricultural Department, University of Wisconsin:

Dear Sir — Another season has passed, and another harvest has been gathered with its lessons of success or failure. That should teach us in future years how to attain success and avert the chances of failure.

Though the past season has been the poorest in many years for growing Amber cane, and its manufacture into syrup and sugar, yet I think we have advanced very materially.

The late cold, wet spring greatly retarded planting, and fully one-third of the amount planted came up so poorly that it was plowed up and other crops planted. This was the case mostly with farmers who had little or no experience in raising cane, and mistook it for pigeon grass, or thought it looked too small to ever pay for the taking care of it. While farmers understanding it better, cultivated it carefully and were paid with good crops. The fall has been very bad for the manufacture of syrup. The grinding season commenced about September 15, and by the 25th it commenced raining and rained almost every day for six weeks, until the country was flooded and roads impassable; some farmers feeding their cane to their cattle, a few of them storing it in their barns, hoping for better weather to haul it to the mill; and after I had finished the cane at the mill and had been shut down nearly a month, I started up to accommodate those farmers and to determine the amount and quality of syrup that could be made from cane kept so long after being cut, which was seven weeks. The result was a fine, light syrup, and about three-fourths of a full crop. Out of this lot was one-half acre from which I made 95½ gallons of syrup, for which the owner was offered sixty cents per gallon at the mill, which speaks well for its quality.

From the unfavorable season we have learned many valuable lessons which a favorable season would not have shown, and solving such difficult problems is taking a firm step in advance towards the time when this industry, with the aid of your department, is to be an established source of business and wealth to the people of the state of Wisconsin.

One great drawback has been the lack of proper knowledge in the manipulation of the juice to obtain the best results, and people starting factories have been so anxious to get such information that they have been the easy prey of traveling sharks, claiming to be experts in the business, referring to some successful factory to which their name may be attached in some capacity, claiming by their skill and superior articles to have accomplished such results, and offering to sell a mill and outfit, for which they ask a fancy price

and will then give full instructions in their secret processes for one cent per gallon on each gallon of syrup made by them during the season. The work of your department will put a stop to this swindling business, and I hope the legislature will appropriate such amounts as may be requisite to fully develop the cane resources, and place Wisconsin in a position to raise her own sugar and syrup, for which she has paid over $8,000,000 per annum. My factory has an easy capacity of 400 gallons syrup in twenty-four hours. I use steam for defecating and evaporating, and the Plantation Mill made by the Madison Manufacturing Company, and no other state can furnish a better one. I would be glad to have you visit my factory in grinding season if possible. Hoping for your complete success in developing the sugar resources of Wisconsin,

I am yours truly,

A. J. DECKER.

To Prof. W. A. Henry, Agr. Dep't, University Wis.

[From J. T. Huntington, Esq., Delton, Wis.]

Prof. W. A. Henry:

Dear Sir — In reply to your request for something from me on the cane business, I submit the following:

The last two seasons have undoubtedly been unfavorable for the best results from Amber cane — the season of '81 particularly as to yield in this vicinity. Notwithstanding that the season was very wet the yield of juice was generally small, but mostly of fine quality, my experience being that the juice of this year worked satisfactorily — much easier than that of last. The syrup from my works this year was, for a custom mill where all sorts of cane is handled, very uniform in quality and color. We have, in this vicinity, all kinds of soil, and so far as I am able as yet to judge, the very best results are obtained from cane grown on soil somewhat sandy, and if possible I would wish it be on a clover sod. The finest flavored syrup and quickest to granulate of any made at my place are those from cane grown on a clover sod. Growers of cane, as a general thing, I think, do not do as they should to obtain the best results. Cane is too apt to be left to be the last thing planted and cultivated, and I have often had men tell me that they had only cultivated it once, and some not at all. Such cane cannot be satisfactory.

In my opinion, cane should be planted just as early as the climate will admit, covering just as light as possible, and cultivating as soon as the rows can be seen; and continue the cultivation until it is waist high, and then keeping the weeds out in August with a hoe.

It should be cut when a majority of the seed is ripe enough to grow, and if it cannot be worked at once, should be so placed that it can have *plenty of air*, and be covered from the rays of the sun or storms ; so placed, it will keep well for some time. I have worked some that had been cut four weeks,

and it was not at all soured — had, perhaps, lost a small portion of the juice. A matter of importance to manufacturers is a better market, or better prices. The name generally applied is sufficient alone to make many refuse to purchase. At a time when ordinary New Orleans molasses is worth 50 to 55 cents in Chicago, at wholesale, 40 cents is considered sufficient to pay for "sorghum," when the fact is that the "sorghum" (when good as it ought to be) is the best goods to be had in the molasses line; and it is also a fact that large quantities of it (some not very good) are purchased in Chicago at very low prices, put into large tanks, and a little very *rank* New Orleans molasses added to give a New Orleans flavor, and then it is rebarreled and sold in the country as genuine New Orleans molasses. Probably those who will not buy "sorghum" direct of the maker, often get it this way. There ought to be a manufacturers' association to work in their interests.

Yours truly,

J. T. HUNTINGTON,

Delton, Wis.

[A letter from Mr. William P. Phillips, of Lake Mills, shows that all do not look upon this question in the same light. Mr. Phillips writes as follows:]

LAKE MILLS, WIS , December 12, 1881.

Prof. W. A. HENRY, University of Wisconsin, Madison, Wis.:

Dear Sir — Your circular of Nov. 10th ult., relative to the Amber cane industry of Wisconsin, received. I am not in any manner interested in that branch of industry and know of no thrifty or practical farmer in this vicinity who is. Its production here is generally confined to a few of the smaller farms — usually those occupied by the poorer and most thriftless class of foreign born immigrants — who are willing to use an inferior syrup of their own production, under the delusion that their time and labor in producing it is worth nothing. Only a few square rods are raised on each farm; and I apprehend if the labor in its production and manufacture was counted at its value in other established practical lines of agricultural business, it would be found to cost many times the market value of much better syrup. In the present stage of development of the crystallizing process, I am unable to appreciate the extraordinary efforts of the national and state departments of agriculture to foster its growth, or to obtain statistics in regard to it. It occurs to me that there are several things connected with the agricultural interests of this country in which the national and state departments — with their aided facilities — might do great service to the country.

We have established, partially developed, practical and profitable industries that need the aid and benefit of the practical experiments of the departments and the protection of the government.

Take as an instance the leading agricultural industry of our state — the dairy industry. Base, unwholesome, disgusting adulterations of dairy pro-

ducts are allowed to be manufactured and sold; our reputation and markets lost, or at least damaged at home and abroad. Millions are thereby lost to the farmers that a few unscrupulous persons, worse than counterfeiters, may defraud consumers out of a few thousands. Yet there has been no effectual law devised or passed; no effort worthy of the name been made to prevent or check the evil. The farmers, an unorganized class, are not capable of helping themselves. The state department of agriculture, as the only organized representative and guardian of the agricultural interests of the state, should repeatedly urge and secure the legislation required in this matter. The law on this subject passed last winter (chapter 40) accomplished nothing, as it was evidently intended it should accomplish nothing.

Again, the science of agriculture is yet comparatively undeveloped. True, it has made great advances in this country during the last half century, mainly by the knowledge gained by the experiments of private individuals. Like all sciences, money generally precedes experimental demonstration. To the private citizen experimental demonstration is often expensive or impracticable for the lack of facilities. The state department of agriculture should have some system of direct communication with the practical agriculturists of the state, by which inquiries might be solicited and answered, and the necessary experiments made at the expense of the state. An agricultural newspaper connected with the department might answer the purpose and be at least partially self-sustaining.

For instance, at the present time our stock and dairy interests require an immediate answer to the question of the economy and practicability of the preservation and use of ensilage as food for stock. We want no floating rumors picked here and there, but an authoritative answer based on the demonstration of reliable experiment.

Thus indefinitely questions daily present themselves to the practical farmer, and if you will inaugurate a system by which they may be satisfactorily answered by the department of agriculture, you will greatly benefit the agricultural industries of the state.

I am very respectfully,

WM. P. PHILLIPS.

[From A. J. Russell, President Wisconsin State Cane Growers' Association.]

JANESVILLE, WIS., December 19, 1881.

Prof. W. A. HENRY:

Dear Sir — In reply to your favor of the 8th, I would say that we have not purchased cane by the ton heretofore, as there was no reliable data to enable the manufacturer to determine the value of the different qualities of cane that was produced on different soils, and delivered at the mill in various conditions.

An imperfect knowledge, and no well developed system of determining the true value of the canes, as delivered promiscuously from a large variety

of soils, has resulted in very serious losses to several large establishments who had adopted the method of purchasing cane delivered at the mill at a stipulated, and generally a uniform price, per ton, or by the acre, irrespective of the purity of the juice contained in such canes.

There seems to be but one practical business method for a manufacturer to adopt for his own protection, and a greater satisfaction to the growers, and that is to purchase the cane by the ton. The manufacturer then has control of all the syrup and sugar, and is not brought into competition in the local or general market, with his own patrons who grow the cane, many of whom have more than sufficient to supply their own and neighbors' wants, and desire to dispose of the balance they have on hand as soon as possible; and not being (as a general rule) familiar with the ruling prices of same class of goods in the wholesale and retail market, are imposed upon by dealers who are perfectly aware of the fact that the grower has not a sufficient amount to ship to jobbing points, and rather than hold it, will sell it at a price to the local dealer generally below the actual market value, and that makes the price for manufacturers to the local trade, as long as the grower's syrup syrup holds out.

We have determined in the future to purchase our cane by the ton, delivered at the mill, and when so delivered will test the juice in the presence of the grower, and purchase it from him, same as grain and other farm products are purchased, according to quality. The actual value of the cane will be determined by the quality of the juice, and will be worth to the manufacturer from $1.50 to $4.50 per ton, and even $5.00 per ton for extra cane, and according to the state of the syrup and sugar market, and the different degrees of purity of the juice, and the amount of sucrose contained in the raw juice at the time of delivery of the cane at the mill.

Our custom has been to charge the growers 25 cents per gallon, or one-half of the syrup.

Our works consist of a storage room 20 by 40 feet, one story, shingle roof building, attached to our defecating, evaporating and finishing building, which is 20 by 20, two stories high, and a shed attached for cane mill, boiler and engine.

Our machinery consists of boiler, engine, mill, juice tank, juice pump, defecators, evaporators, finishing-pan, cooler and storage tanks.

The juice runs directly from the mill to the juice tank, and is pumped up to the top floor into the defecator, and after the defecation is made, it is discharged directly into the evaporator and rapidly reduced to a thin semi-syrup, and is then discharged into the finishing pan and concentrated rapidly, if for syrup, to a commercial density, and drawn off into the cooler, and almost immediately discharged into storage tanks sufficiently large to hold, each one of them, a little over a car load.

When enough has been made for a car load, the barrels, three of them at a time, are rolled under faucets and filled. In that way it does not take us long to fill enough barrels for a car load. We then ship generally to a wholesale

market. Thus we have a continuous fall from the defecator to the barrels, without any rehandling of the syrups; and by cooling the syrup at once, after discharging into the cooler, it prevents the syrup from darkening by being syrup scorched in running a succession of batches of hot syrup into a tank at a high temperature of heat, so long that it darkens the syrup and lessens its value as a commercial article.

Our machinery is constructed and arranged to save labor and more perfectly clarify the juice and hasten the evaporation in the most rapid manner. Our defecators are so arranged and constructed that we do not have to skim the juice in them, and a simple attachment we have, permits drawing the juice into the evaporator, as clear as water. The knowledge of the fact gained by our own practical experience that the success of making a bright, glossy sugar, and a light colored, clear, transparent syrup, "without" the use of the expensive "char-filters," depended upon a perfect defecation, and a rapid concentration of the juice to the required density, enabled us to build a style of evaporator that has produced the desired result, by enabling us to concentrate the juice rapidly, and at the same time liberate certain impurities that can be eliminated in no other manner known to us but by the application of heat; and when those impurities are separated and thrown to the surface, they flow rapidly to the automatic skimmer and filter, where they are retained and forced over into the scum trough in a comparatively dry condition, and the strained and filtered juice passing through the filter rapidly, is returned immediately to the evaporator, again clear and transparent. In this manner we keep up a constant current, flowing on top to the automatic skimmer and filter, and another reverse current of the filtered juice returning by way of the bottom of the pan, to again come in contact with the heat and thrown to the top, separating the remaining impurities, and keeping up a constant circulation of the juice and producing the most rapid evaporation that can be made, and the strainer and filter catching and retaining all the impurities of the minutest character that have been separated from the juice, and preventing them from again mingling with the boiling juice, and giving it a bad flavor and darker and cloudy appearance. All experts in the use of steam concede that in order to produce the most rapid evaporation, there must be a constant circulation, and we are very much gratified with the manner in which our pans have operated, as they have enabled us to produce an article of syrup that has sold in the wholesale markets in competition with the best products of the country, made by either the open pan train or vacuum pan and char filters combined.

It saves labor, and above all things we prize it on account of its perfect work skimming the juice, and not endangering a depreciation in the value of the syrup by being imperfectly skimmed by tired and careless help; for without perfect skimming off of the impurities after they have once been separated, to keep them from being reboiled into the syrup again, there is danger that more or less of the batches or strikes will be run into the storage tank in a cloudy condition, and consequently of bad flavor, and help to destroy

or depreciate what good syrup there is in the tank; and if it is intended for sugar, it will be what is called a gray sugar, having a dull, dirty appearance. It was a case of this kind that occurred to us when we first commenced that suggested this plan of evaporation to me for our own safety and protection.

Our finishing pan is similar to our evaporator, but smaller in dimensions.

Our cooler works admirably, and is actually necessary in large works to cool the syrup immediately after finishing for commercial use or for sugar making.

Our whole outfit, including land, buildings and machinery, cost about $6,000, and has a capacity of making from eight to twelve hundred gallons of syrup per day. The amount of syrup made per day depends mostly upon the strength of the juice we are making.

In regard to my ideas of the future of this industry, I would say I have had no occasion to change my opinion expressed three years ago. I then made up my mind that if the industry was conducted on strictly business principles there was money in it for the farmer and the manufacturer of syrup alone, even if they should fail to produce sugar; and my past experience has confirmed that belief. And your own valuable experiments made at the University farm this past season, with the able assistence of the department chemist, Mr. Swenson, will dispel the doubts that existed in the minds of many, who could not possibly be persuaded to believe that sugar could be produced here at home, grown on our own farms.

The many central works and refineries devoted exclusively to the sorgo industry, that have been put in operation in many of the states, at a cost of from $5,000 to $60,000 each, is evidence of the fact that the most timid and skeptical factor in the development of this new industry — capital — has become convinced that it is a safe investment; after the most careful and searching scrutiny have united with science and skill and are partly carrying out the idea of central works, that I have been laboring to establish in this state, and the fine results you have obtained in your experiments will hasten the time of its realization.

There seems to me to be no other practical way of meeting the requirements of this rapidly growing business than by establishing central works.

A central works located at some point accessible by rail from several directions, to facilitate receiving raw syrups from a large amount of territory, and fully equipped with all the latest improved mechanical appliances that have been tested and proven to be well adapted to the manipulation of the sorgo juice, to manufacture a first class commercial syrup, and a soft white and yellow sugar. The central works should have a capacity of grinding from 300 to 500 acres of cane annually, to insure having a sufficient amount of business early in the season, so as to keep the works in operation as much as possible during the year. The central works could have nearly or quite all of their crop worked up before they would be able to obtain semi-syrup from the auxiliary works, for making sugar and refined syrups from. The central works should be under the management of some one who

has a practical knowledge, and is qualified to instruct operators of the auxiliary works how to make the semi-syrup and leave it in proper condition for the central works.

Suitable buildings and machinery to work up 500 acres of cane, and rework the semi-syrup made by the auxiliary works, from 3 500 acres, into sugars and syrups, taking eight months in the year, would cost $25,0C0, all fitted up ready for business.

It is not practicable to haul the cane more than three miles to mill, and to obtain a sufficient amount of raw syrups for a central works of such a character requires many auxiliary works, large and small, operated by steam or open fire train (steam being the cheapest and best, and destroys less sucrose, is preferable), to make the semi-syrup, which an intelligent and careful operator can do successfully by working under instructions from a competent manager of a central works.

To fit up a steam train so all the machinery will be properly proportioned, to insure the least expense in manufacturing, and produce an acceptable article, requires the aid of some one who has sufficient practical knowledge to determine, when informed of the number of acres designed to be worked, the size of mill required, the amount of steam-generating power required, beyond the motive power, to evaporate the amount of juice expressed by the mill in less than an hour, and the number of square feet of heating surface it takes, with a given quantity of steam under a certain pressure, to evaporate the juice of a minimum strength down to semi-syrup, in the required time to produce the best results.

The lack of knowledge on these very essential points has been the means of causing some losses and discouragements to the owners of the works, and the growers of the cane also.

In conclusion, I beg leave to say in behalf of many farmers who have raised the cane, and many more who desire to do so, that I have conversed with on this subject in many different parts of our state, that they hope our representatives at Madison will realize what great interest it will be to the farmers and to the wealth of the state for them to make a special appropriation sufficent to enable you and your very able assistant, Mr. Swenson, the department chemist, to continue the valuable experiments you have commenced and that have produced such splendid results, as to justify the belief that this new and valuable crop will be extensively raised by the farmers of this state in the near future.

They feel they have a right to ask for an appropriation for their agricultural department to make intelligent and systematic experiments (which the farmers are unable to do), to determine for them the best soils, fertilizers, etc., to use in developing for them a crop that gives such good promise of being of so great a value to them and the whole state. They also feel that they are behind the times in this matter, as other states have realized the importance of this crop to such an extent that they not only pay a premium on every pound of sugar that is made from the native cane raised in the state,

and exempt from taxation for five years all the machinery employed in sugar making, but to encourage the farmers in growing cane they pay them a premium for every ton of cane they produce.

Hoping that you may be permitted to continue your experiments in this sugar industry with a sufficient amount of money at your disposal to enable you to extend your field of usefulness in this and any other direction that will be of benefit to our farming community, I remain

Respectfully yours,
A. J. RUSSELL.

[From J. D. Sherwood, Green Lake county.]

DARTFORD, GREEN LAKE COUNTY, WIS., December 18, 1881.

Prof. HENRY, Madison, Wis.:

Dear Sir — In reply to your favor of 8th ult., would say that I rolled 347½ tons, averaging 7° B., allowing on the basis of 50 per cent. of juice, expressed 10½ gallons to the ton, which basis has given about 100 gallons to the acre on clay and sandy loam soil. The highest yield was $6\frac{588}{2000}$ tons, testing 8° B., from one-third of an acre, raised by Wm. McConnell, of this town, being at the rate of 238 gallons per acre, and the lowest yield high about 30 gallons to the acre, juice 3° B. Commenced September 9 on the above yield, the seed of which was ripe. But most of the after working was dough to ripe. Most of the cane was planted after other work, and then it has paid better than anything else; but not as well as last year, owing to the peculiar season. The cost of working our crop of eight acres was ten days' work fitting ground; eight days' work planting and cultivating; five days' work thinning out; forty-five days work stripping and cutting, and then only one-half of it stripped, as it was badly lodged; twenty-four days' work and team drawing one and a half miles; making ninety two days' work for 70¾ tons, testing 7° B., which was worked at twenty cents per gallon, and also at the halves, costing to manufacturers, including the twenty per cent. wear on outfit costing about $4,000, fourteen cents per gallon, which is more than it will next, owing to being inexperienced in everything. But still the consumers are well pleased, saying that they cannot replace it from the grocery. Families are using five gallons where they only used one before, with a very great difference in their sugar bill to their credit; and why not? It is cane sugar instead of the insipid glucose backed with a little sorghum that is dealt out by most of the stores as "sugar house." There is no doubt at all in the fact that very soon we shall manufacture most of sugar and syrup and my very greatest fear is that it will be overdone, as those who raise it increase their acreage. I find that the best sales are made where it is known. It brings from 45 to 60 cents per gallon.

My outfit is a 3½ Niles and complete steam train, with 12 horse-power engine and 45 horse-power boiler, from Blymer & Co., Cincinnati, Ohio. Burn bagasse and coal, which makes the cost about five cents per gallon.

Trusting that the above hastily condensed items are encouraging to you in you practical endeavors to place on a good foundation one of the best industries of the northwest, and hoping that success will continue to crown your labors, I remain

Very truly yours,

J. D. SHERWOOD.

[The following extract from a letter from Joseph H. Osborn, Esq.. Oshkosh, Wisconsin, contains some valuable suggestions:]

"I am satisfied that the sooner cane is worked up after it is cut, the better will be the character of the syrup made from it. I have no faith in the *curing* process which has been recommended frequently.

"Again, the cane should be kept *clean*. Carelessness in this respect cannot be remedied in small works like mine. The dirt will be carried through into the syrup and is very damaging in its effect. Large establishments might provide for taking it out, but in this case prevention is better than cure.

"I am very glad that the farmer and rural manufacturer is likely to have the aid of scientific gentlemen in developing this 'new industry.'

"There are a great many things in connection with the manufacture of syrup, the proper knowledge of which must come from a scientific source. Among these is the *correct method* of using the saccharometer. Scarcely a writer in the *Rural World*, upon the subject of Amber cane culture and manufacture, but refers to the test of the juice by the saccharometer. He may tell how he planted the seed and when; *how* he cared for the crop, and *how* he harvested it; but when he says the juice tested 7° B. or 12° B., he does *not* state what were the conditions of the test. Did he test the juice as it run from the machine? If so, did he also test it by the *thermometer?* If it was not 60° by the thermometer, did he take means to make it so? If yea, *how* did he proceed?

"Again, if he tested the juice by the saccharometer as it came directly from the mill, and also by the thermometer, even if the latter indicated 60°, did he allow the juice to stand an hour and test it again; and, if so, was the result the same? I think not; my experience is that there will be several degrees difference. If Prof. Collier stated that juice tested a certain degree, I should of course know that the conditions of test were correct; but from my own experience, I doubt very much if all the writers for the *Rural World* who state results by the saccharometer, can be relied upon as having secured the correct conditions necessary for the test. It seems to me that correct information upon the correct use of the saccharometer should be given in a popular way for the benefits of those engaged in this Amber cane business.

"Again, in regard to the use of lime. Are we to accept it for a settled fact that if the *cold* juice is tested with lime, that it can be allowed to stand without injury for a length of time. (If so, how long?) If I remember correctly, this statement was made by Prof. ———, of Illinois, through the *Rural World*.

"Again, granted that lime is used with the *cold* juice, and heat subsequently applied to aid defecation, should the evaporation be proceeded with at once, or could the warm juice be allowed to stand any length of time; and if so, would it aid the clarification, or should, or could some additional method of clarification be used before commencing the evaporation?

"Again, in years gone by, when the making of sugar from corn stalks was talked about, the removal of the young ears of corn was said to be essential to develop the greatest amount of sugar in the stalk. Question. Would science consider that the removal of the young seed tuft from the cane would add to the strength of the cane juice? Your circular called for *facts*. I have given mostly suggestions, or at least I hope you will consider, and treat them as such.

Truly yours,

"JOSEPH H. ORTON."

[To those in doubt as to whether it pays to grow cane, I would refer the following letter sent me by one of our careful farmers. It is the most complete statement I have yet seen and deserves careful attention:]

KENOSHA, WIS., February 26, 1881.

Professor W. A. HENRY, Madison, Wisconsin:

Dear Sir — I herewith give you the result of growing one acre of Amber sugar cane in 1880. The plot of ground is composed of black muck, verging into a sand loam, two-thirds of the plot being the former and one-third the latter. There were about four rods of very low ground on which the cane grew very rank and lodged. There was no waste ground. In 1879 it was heavily manured and a *very heavy* growth of drilled fodder corn raised, and plowed that fall. The ground was dragged and marked in rows one way, three feet and a half apart, extending north and south, on May 20th, and on May 21st it was planted by hand, dropping the seed in the marks made by the marker and covering with the foot. Two pounds of seed were used. One-half of it was planted from twelve to eighteen inches apart and the other from twelve to twenty five inches. I think it would average seven or eight seed to a hill. It was then rolled, and cultivated twice with a two-horse cultivator. One man spent one day on the piece with the hoe cutting out grass between the hills. This would not have been necessary had the seed come up evenly. One-third of the piece was dry and the seed not being covered any deeper, did not come up for two weeks, hence could not cultivate it evenly. It was stripped by hand at intervals from September 14th to September 27th, cut and bound September 28th, drawn to mill on the 29th and 30th, carefully weighed and piled. Total weight, $13\frac{1235}{2000}$ tons.

The first half, or that planted the thickest, weighed about eight tons, and the other half $5\frac{1235}{2000}$ tons. The cane was made up October 7th, and yielded one hundred and seventy gallons of syrup, weighing eleven and a half pounds to the gallon. The juice tested $7\frac{3}{4}$ by the saccharometer and was boiled down to forty. There was one load of leaves saved for fodder, and

three double boxes of seed which was fed to the pigs. I estimate the value of the crop as follows:

Dr.		Cr.	
To interest on land	$2 00	By fodder	$10 00
half day's work plowing...	1 50	170 gallons syrup at 50c ..	85 00
dragging and marking.....	50		$95 00
two pounds seed	70		
planting	1 00		
hoeing.................. ...	1 00		
cultivating................	1 00		
stripping	6 00		
cutting and binding	3 00		
topping and hauling.......	10 30		
hauling fodder and feed ..	1 00		
4 barrels at 75c............	3 00		
making 170 gallons at 20c..	34 00		
	$65 00		
Balance	30 00		
	$95 00		

M. O. MYRICK.

[The following letter from H. W. Small & Co., Chicago, will certainly be read with interest. It should be remembered that from the peculiar line of business of this company — that of supplying the wholesale trade with syrups and molasses — it is in a position unequalled by any other company in the west to judge upon the true merits of the case:]

CHICAGO, December 28, 1881.

Prof. W. A. HENRY, Madison:

Dear Sir — We have your favor of 24th, with samples of sugar and syrup before us. You have obtained a remarkable yield from your experimental one-fifth acre. One thousand pounds of good brown sugar and eighty gallons of syrup per acre would be a very profitable crop for any of our farmers, and we read with very much interest your statement that the analysis of the cane showed nearly *twice the quantity of sugar* that you obtained; or, in other words, that the processes for extracting the sugar from Amber cane is so imperfectly understood, at present, even by our most scientific men, that nearly one-half the yield is lost. Well, this only confirms our opinion the more strongly that the profitable raising of Amber cane in the north, for the manufacture of sugar and syrup or molasses, is no longer an experiment, but an assured fact; and, although but just in its infancy, enough has been already done to show that *skill in its manufacture* is the one great requirement.

Now, we not only would not advise every farmer to rush in blindly and plant a few quarter acres of Amber cane, but we would advise that they

do no such thing until you, who are giving so much time and attention to this business, learn how, and "*write a book*" *of instructions*, so that every farmer may know how, without the possibility of a failure. Then "*exit*" *New Orleans*, "*enter*" *Amber*.

We have received samples of Amber molasses, this season, that compare favorably with "New Orleans," while other lots have been very poor; and the difference, so far as we can learn, was not so much in the soil, or climate, or seed, as in the "modus operandi" of manufacture.

The sugar is there; the molasses is there. How to secure it, after it is grown and ready for the mill, is the one great question for you scientific men. We sincerely hope that the state will continue to foster this industry until it is thoroughly understood, so that every farmer can grow his own sugar and molasses at one quarter the present price of New Orleans, and, what may be even better than that, *know* that they have an *absolutely pure* article.

The better grades of Amber are slowly overcoming the old prejudice against sorghum, and we believe the time not far distant when a choice Amber molasses will be more sought after than a somewhat doubtful mixture of New Orleans glucose and syrup.

Wishing you every success, we are

Yours truly,

H. W. SMALL & CO.

[The following letter will show what the state of New Jersey has done: Mr. Bishop, as *Chief of the Bureau of Labor and Statistics*, has a rare chance of getting at reliable facts in this matter]

OFFICE OF BUREAU OF STATISTICS OF LABOR AND INDUSTRIES,

TRENTON, N. J., January 31, 1882.

Dear Sir:— Your valued favor of the 27th is at hand, but as my 4th annual report is now in the hands of the printer and proof coming in daily, I can only give a hasty sketch of what has been done in New Jersey in the manufacture of sugar.

At the last session of the legislature an act was passed entitled "an act to encourage the manufacture of sugar in the state of New Jersey," approved February 16, 1881 (a copy of the act will be found on page 14 of the Introduction in the 3d annual report of the Bureau).

Mr. John Hitgerth, a practical sugar manufacturer of Philadelphia, had been experimenting for about two years with the juice of the sorghum, having contracted with some farmer of South Jersey to raise the cane for him. He put up a horse power mill to crush the cane, and putting the juice in casks, sent it to his works for treatment, and became fully satisfied from his experiment that sugar in paying quantities could be made from the best varieties of sorghum cane.

In the spring of 1881, Mr. H. went into Cape May county, New Jersey, and induced a number of farmers to put in sorghum as a farm crop, and entered into contracts covering about sixty acres, to take the crop of cane, stripped of its leaves and top, at two dollars per ton of 2,000 pounds, delivered at any point on the West Jersey railroad, he paying the freight to his factory. The estimate made for the farmers was in substance as follows:

Average tons cane per acre, ten, at $2 per ton	$20 00
State bounty, $1 per acre	10 00
35 bushels seed, worth, at lowest estimate, 50 cents per bushel	17 50
Total	$47 50

Thus giving to the farmer $47.50 per acre for his crop, and leaving him the leaves, etc., to use for fodder.

The season being one of unusual drought, the average, as nearly as I can estimate, was only 8 tons to the acre; but the seed seemed to be but slightly affected in yield, and gave 3½ bushels to the ton, selling for 75 cents per bushel of 60 pounds. It is considered for feeding purposes fully equal to Indian corn.

Having thus contracted for his cane, Mr. H. proceeded in the spring to erect a factory at Rio Grande, a station on the W. J. R. R., about 6 miles from Cape May. The factory was filled up with the usual machinery for making sugar from the juice: steam evaporators, defecators, vacuum pan, centrifugals, etc. A large mill for crushing the cane was placed on the first floor, the whole being run by an engine of 200-horse power. The total cost was $65,000. During the busy season the mill was run twenty hours a day, and used 200 tons cane, turning out 15 000 pounds good merchantable sugar, worth 8 cents per pound in Philadelphia.

The state has paid a bounty on 1,500 tons cane to the present, distributed among 50 farmers. Applications for bounty are coming in every week, and doubtless many who raised small amounts will never apply. With regard to the number of pounds of sugar made, although Mr. Hitgerth is entitled to a bounty of one cent per pound, he declines filing a certificate certifying to the amount; therefore when I say it was not far from 20,000 pounds it is only an estimate. What the farmers of New Jersey think about the cultivation of sorghum as a crop, may be judged from the following quotations from their letters:

"I threshed about 1,500 bushels of seed, the yield of cane being 6 to 8 tons per acre; it will yield from 3 to 3½ bushels to the ton, and is selling here for 70 cents per bushel. It is superior to corn for fattening hogs and chickens, and is a first class feed for cattle as it makes plenty of milk."

"It is no more expensive to cultivate than corn; the harvesting may cost about 10 per cent. more."

"My experience has led me to believe that it is a profitable crop, consequently I am going to plant 200 acres the coming year."

I have thus given briefly and in haste the points named in your letter, and

hope the state of Wisconsin may be induced to promote the rapid development of an industry whose future is so bright, and the fruits of which will bring such prosperity to our agriculturists.

Yours very truly,

JOHN BISHOP,

Chief.

THE BEET SUGAR INDUSTRY IN FRANCE.

I would invite the attention of those who are unwilling to give Amber cane a fair trial, to consider the early history and present condition of the beet sugar industry in France.

It would appear most probable that slave labor in the tropics with such a plant for elaborating the sugar as the Ribbon cane, would forever prevent peasant labor on high priced land which had been for centuries under cultivation, from making such a plant as the beet yield a profitable income, yet by the most rigid applications of science combined with careful management of machinery and strictest economy in saving all by-products, France is now producing over fifty million dollars worth of sugar per year.

I present the following facts taken from Dr. McMurtrie's report on the culture of the sugar beet:[1]

In 1797 Karl Franz Achard announced to the Institute of France that he was able to manufacture sugar from the beet, at a cost not exceeding six cents per pound. Though his statement was met with ridicule, a committee was appointed by the Institute to examine his methods and repeat his experiments.

They reported as a result of these tests that a good raw sugar could be manufactured for about eighteen cents per pound, though this figure might be somewhat reduced by improved methods. This report dampened the ardor of the French, and nothing was done by them for a time, but in Germany, Achard and Baron de Koppy each erected works and made considerable quantities of sugar.

The famous Berlin and Milan decrees, which excluded all products of English manufacture, so enhanced the prices of sugar in Europe that these manufactories paid good profits, and this coupled with need, again drew the attention of the French to the solution of the problem. The enthusiasm of the Emperor

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[1] Report on the culture of the sugar beet and the manufacture of sugar therefrom in France and the United States, by Wm. McMurtrie, E. M. Ph. D. Washington, 1880.

Napoleon was enlisted at this time, and nothing can better exhibit the indomitable energy which he showed in every act than his first decree relative to the sugar and indigo industries. I give a copy of it entire:

PALACE OF THE TUILLERIES, March 25, 1811.

NAPOLEON, Emperor of the French, etc.:

Upon a report of a commission appointed to examine the means proposed to naturalize, upon the continent of our empire, sugar, indigo, cotton and divers other productions of the two Indies:

Upon presentation made to us of a considerable quantity of beet-root sugar, refined, crystallized and possessing all the qualities and properties of cane sugar:

Upon the presentation made to us at the council of commerce of a great quantity of indigo, extracted from the plant woad, which our departments of the south produce in abundance, and which indigo has all the properties of the indigo of the two Indies:

Having reason to expect that by means of these two precious discoveries our empire will shortly be relieved from an exportation of 100,000,000 francs ($20,000,000) hitherto necessary for supplying the consumption of sugar and indigo:

We have decreed and do decree as follows:

Article 1. Plantations of beet root proper for the manufacture of sugar shall be formed in our empire to the extent of 32,000 hectares (79,040 acres).

Article 2. Our minister of the interior shall distribute 32,000 hectares among the departments of our empire, taking into consideration those departments where the culture of tobacco may be established, and those which from the nature of the soil may be more favorable to the culture of the beet root.

Article 3. Our prefects shall take measures that the number of hectares allotted to their respective departments shall be in full cultivation this year, or next year at the latest.

Article 4. A certain number of hectares shall be laid out in our empire in plantations of woad, proper to the manufacture of indigo, in the proportion necessary for our manufacture.

Article 5. Our minister of the interior shall distribute the said number among the departments of our empire, taking into particular consideration the departments beyond the Alps and those of the south, where this branch of industry formerly made great progress.

Article 6. Our prefects shall take measures that the number of hectares allotted to their departments shall be in full cultivation next year at the latest.

Article 7. The commission shall, before the 4th of May, fix upon the most convenient places for the establishment of six experimental schools for giving instruction in the manufacture of beet-root sugar, conformably to the processes of chemists.

Article 8. The commission shall also, before the same date, fix upon the places most convenient for the establishment of four experimental schools for giving instruction upon the extraction of indigo from the lees of woad, according to the processes approved by the commission.

Article 9. Our minister of the interior shall make known to the prefects in what places these schools shall be formed, and to which pupils destined to this manufacture should be sent. Proprietors and farmers who may wish to attend a course of lectures in said experimental schools shall be admitted thereto.

Article 10. Messrs. Barruel and Isuard, who have brought to perfection the processes for extracting sugar from the beet root, shall be specially charged with the direction of two of the six experimental schools.

Article 11. Our minister of the interior shall, in consequence, cause to be paid the sum necessary for the formation of the said establishment, which sum shall be charged to the fund of 1,000,000 francs ($200,000) in the budget of 1811, at the disposal of the said minister for the encouragement of beet-root sugar and woad indigo.

Article 12. From 1st of January, 1813, and upon a report to be made to our minister of the interior, the sugar and indigo of the two Indies shall be prohibited, and considered as merchandise of English manufacture, or proceeding from English commerce.

Article 13. Our minister of the interior is charged with the execution of the present decree.

The following decree shows that in 1812 the subject was still under consideration:

SECTION I.—*School for Manufacture of Beet-Root Sugar.*

Article 1. The factory of Messrs. Barruel and Chappelet, plain of Vertus, and those established at Wachenheim, department of Mont-Tonnere, at Douai, Strasbourg, and at Castelnaudary, are established as special schools for the manufacture of beet-root sugar.

Article 2. One hundred students shall be attached to these schools, viz: 40 at that of Messrs. Barruel and Chappelet, and 15 at each of those at Wachenheim, Douai, Strasbourg, and Castelnaudary; total, 100.

Article 3. These students shall be selected from among the students in medicine, pharmacy and chemistry.

SECTION II.—*Culture of Beets.*

Article 4. Our minister of the interior shall take measures to cause to be sown throughout our empire 100,000 metrical arpents of beets. The conditions of the distribution of the culture shall be printed and sent to the prefects previous to February 15.

SECTION III.—*Manufacture.*

Article 5. There shall be accorded throughout our entire empire 500 licenses for the manufacture of beet-root sugar.

Article 6. These licenses shall be accorded of preference to all proprietors of factories and refineries; to all who have manufactured sugar during 1811; to all who have made preparations and expenditures for the establishment of factories for work in 1812.

Article 7. Of these licenses there shall be accorded of right one to each department.

Article 8. Prefects shall write to all proprietors of refineries in order that they make their submissions for the establishment of said factories at the close of 1812. In default of the proprietors of refineries to have made their submissions prior to March 15, or at the latest April 15, they shall be considered as having renounced the preference accorded them.

Article 9. Licenses shall include an obligation on the part of those who shall receive them to establish a factory capable of producing at least 10,000 kilograms (22,000 pounds) of raw sugar in 1812-13.

Article 10. Each individual who, having received a license, shall have actually manufactured nearly 10,000 kilograms of raw sugar resulting from the crop of 1812 to 1813, shall have the privilege and assurance, by way of encouragement, of being subject to no tax or *octroi* upon the product of his manufacture for the space of four years.

Article 11. Each individual who shall perfect the manufacture of sugar in such a manner as to obtain a larger quantity from the beet; or who shall invent a more simple and economical method of manufacture, shall obtain a license for a longer time, with the assurance that no duty or *octroi* shall be placed upon the product of his manufacture during the continuance of his license.

SECTION IV.—*Creation of Four Imperial Factories.*

Article 12. Four imperial beet-sugar factories shall be established in 1812 under the care of our minister of the interior.

Article 13. These factories shall be so arranged as to produce with the crop of 1812 to 1813, 2,000,000 kilograms of raw sugar.

Under this stimulus in 1813, 334 factories prepared 7,700,000 pounds of beet sugar. The industry developed rapidly under the fostering care of Napoleon, until his downfall. With the overthrow of the monarch, all of the factories were wrecked except one. The high duties imposed by the new government soon again made the business profitable; factories were again opened, and from that time to the present it has received no check of serious importance. The following table will show the condition of this industry in 1873, 1874 and 1875:

	1873.	1874.	1875.
Number of factories	532	543	539
Laborers employed	73,485	74,875	68,582
Force employed, horse-power	62,819	69,999	71,335
Production of sugar, tons	409,916	423,222	463,122
Production of molasses, tons	231,770	214,017	199,243
Total value of production	$54,185,704	$54,294,968	$54,425,757

The tax levied by the French government upon home manufactured raw sugar is 73.50 francs ($14.90) per 100 kilograms (220 pounds). The duty upon sugar imported in France varies from 65.52 to 71.76 francs per 100 kilograms, according to quality, etc.

In 1877 and 1878 the sum realized from taxes on home made sugar by the government of France was as follows:

Kinds of Sugars.	1877.	1878.
Import duty on colonial sugar	$7,540,800	$6,768,760
Import duty on foreign sugar	6,886,000	8,642,000
Duty on manufacture of indigenous sugars	22,088,400	17,035,600
Total	$36,515,200	$32,446,360

The cost of manufacturing sugar from beets is given by Dr. McMurtrie in the following table:

"Statement of expenses and receipts resulting from the transformation of one ton (2,200 pounds) of beets into raw sugar, Nos. 7-9 to No. 13, molasses at 40° and other residues — the beets delivered at the works, the sugars delivered at station, molasses and other residues taken at the works."

[The figures of the tables give the average of four factories, producing annually about 10,000 sacks (220 pounds each) of raw sugar, and working by means of new processes and machinery, double saturation of the juice, triple effect for the evaporation and boiling for crystallization (*cuite en grains*) of the syrups.]

Detail of Expenses for One Ton (2,200 lbs.) of Beets.

Nomenclature of the principal general costs of manufacture.	1873-74.	1874-75.	1875-76.	1876-77.	1877-78.
Purchase of beets..............	$4 00	$4 09	$4 07	$3 76	$4 11
Pay of laborers...............	76	74	77	71	72
Employees	18	17	16	18	18
Incidentals	02	02	02	02	02
Patent rights...	08	07	07	08	08
Repair of machinery.	41	39	43	47	33
Duty [1]......................	... ...	....	....	....	....
Transportation.................	29	31	27	23	23
Oils, grease, etc...............	08	07	07	07	07
Animal charcoal...............	08	08	07	06	06
Insurance of workmen...... ...	02	02	01	01	01
Discounts, interests, commission	24	20	19	28	27
Limestone and coke............	09	07	08	09	09
Coal..........................	68	67	70	56	56
Woolen sacks, sugar sacks, etc .	16	15	16	16	16
Total	$7 09	$7 05	$7 07	$6 68	$6 89

[1] The duty on sugar, equivalent to 73.50 francs, $14.90 per 100 kilograms (220 lbs.) of raw sugar, is not comprised in the figures noted here, neither in the expenses nor in the receipts. The public treasury accords four months of credit to the refiner, who is charged with the payment of this tax, and it is therefore not included in the price of sale.

DETAIL OF PRODUCTS FROM ONE TON (2,200 LBS.) OF BEETS.

	1873-74.			1874-75.			1875-76.			1876-77.			1877-78.		
	Quantity.	Price of sale.*	Total.	Quantity.	Price of sale.*	Total.	Quantity.	Price of sale.	Total.	Quantity.	Price of sale.*	Total.	Quantity.	Price of sale.*	Total.
	lbs.			*lbs.*			*lbs.*			*lbs.*			*lbs.*		
Sugar	124.74	$11 04	$6 26	128.26	$11 78	$6 87	117 04	$10 11	$5 42	97.68	$13 76	$6 11	133.65	$12 06	$7 33
Molasses	79.20	2 78	1 00	74.80	2 26	77	80.96	1 52	56	69.96	2 30	73	77.88	2 50	89
Pulps	517.00	2 08	49	517.00	2 13	50	523.60	2 10	54	572.00	2 30	60	585.20	2 24	59
Scums of saturation	125.40	2 00	15	114.40	2 00	10	158.40	2 00	14	129.80	2 00	12	151.80	2 00	14
Manures and other matters	176.00	05	04	118.80	05	03	290.20	05	05	220.00	05	05	220.00	05	05
Total	......	......	$7 94	......	......	$8 27	......	......	$6 71	......	......	$7 61	......	......	$9 00

* Per quintal of 220 pounds.

Recapitulation.

[In this statement is not included the interest upon the joint capital, this capital being variable according as the works are old or new.]

	1873–74.	1874–75.	1875–76.	1876–77.	1877–78.
Total value of products	$7 90	$8 27	$6 67	$7 61	$8 99
Total expenses	7 08	7 06	7 06	6 68	6 88
Difference in loss	....	....	39	....	....
Difference in profits	82	1 22	.. ....	93	2 12

THE ENSILAGE OF FODDERS.

THE SILO.

Conformatory to the act of the legislature, a silo was built upon the farm for the preservation of green fodders. It is 30 feet long, 15 feet wide, outside measurement, and 15 feet deep. The walls are 18 inches thick, the material being sandstone rubble, laid in strong mortar. It stands about half under ground with the end joining the main barn. There are no doors or openings of any kind on the sides or bottom, which are well coated with Milwaukee cement, so as to be air and water tight. Over this silo or cellar is a low frame building with the sides 6 feet in height and 11 feet to the peak of the roof. Inside of the superstructure is a 3-foot wall of 2-inch plank set on edge running all around it, forming a continuation of the stone wall of the silo proper. By means of this plank wall the silo can be filled with ensilage three feet higher than the stone wall. Yet upon settling, all the ensilage will be pressed within the silo proper.

From this description it will be seen that the silo is simply a stone cellar with cemented walls, or we may term it an immense cistern. Over this cellar is placed a low building to keep out rain. The silo is entered from the main barn floor, which is on a level with the top of the stone wall, a doorway being cut in the side of the barn for this purpose. A ladder is used to reach the bottom of the silo. The ensilage is passed out through large double doors at the end of the superstructure.

The best location for the silo is of course on a side hill with only an end exposed, if possible, and in this, near the bottom, to have a door for taking out the ensilage. We unfortunately have no sidehill near the farm buildings, and as the silo could be put half under ground, it seemed the cheapest and most convenient to have no opening on the sides, but to lift the ensilage from the bottom clear over the top of the wall by horse power. This process will be described later.

The stone for the silo was drawn from the quarry at odd times by the farm teams, and this expense, together with the cost of excavation, are not included in the account of expenses.

The other items are as follows:

25 days' work by masons at $3	$75 00
12 days' labor at $1.75	21 00
15 days' labor at $1.25	18 75
21 cords of stone at $2.50	52 50
13 barrels cement at $2	26 00
70 bushels lime at 28 cents	19 60
Frame building over silo, etc	119 41
Ensilage cutter, including freight	81 27
Total	$413 42

All this was done in the best manner possible, as it was desirable to have no failure from an unfit building. The floor was made of small boulders bedded in cement and is nearly six inches thick, as I was greatly afraid that during wet weather water would be forced up through the bottom. The walls inside are cemented so as to be smooth, and offer no projections on which the planks covering the ensilage might catch in settling.

The cost of this silo is no criterion for others. Any farmer can soon ascertain what one will cost him by asking "what will a cellar of desired size, built of stone, brick or concrete, and cemented inside, cost me here on my own farm?"

Add to this the cost of some kind of roof to keep out rain, and enough two inch plank to make a covering over the ensilage when the silo is filled, and you have the cost of the silo. These conditions vary, of course, with every section and farm.

As this silo stands about half above ground, the ensilage is in danger of freezing in winter. This I shall obviate by stacking bundles of corn fodder about the building on the three exposed sides.

FODDERS FOR ENSILAGE.

The crop relied upon for filling the silo was fodder corn.

The first plot of fodder corn was about two and a half acres in extent. The soil was a low clay alluvial, not sufficiently elevated above Fourth Lake to yield the largest crops. The ground had been in corn for several seasons past, and was fertilized in the spring with barnyard manure, at the rate of twelve loads per acre. The plot would have brought from thirty-five to forty bushels of shelled corn per acre this season, I should judge, had it been planted to that crop.

The ground was prepared as for corn, furrowed thirty inches apart, and corn dropped in the rows at the rate of seventy-five grains per rod, and carefully covered by hand. The seed was a variety of yellow dent grown upon the farm for several past. The stalks of the variety are somewhat smaller than those from states south of Wisconsin.

The planting was done May 27th. This plot was very promising at first and was pronounced the best on the place by visitors at the farm the last of June. It was cultivated three times and was entirely free from weeds at cutting time. In August some of the corn plants turned an unhealthy yellow color, and the corn when tasseled was not over six and a half or seven feet high. No cause can be given for this condition, except that the plants were too much crowded. No ears formed upon the stalks, except very small ones in a few cases. At cutting time the small stalks were as sweet as Amber cane stalks and filled with juice. Owing to the drought then prevailing some of the lower leaves were dead. The second plot of ensilage corn was grown upon land which had yielded over eighty bushels of shelled corn per acre the year previous. It was fertilized with rotted barnyard manure at the rate of thirty small two-horse wagon loads to the acre. The ground was in perfect condition at planting time. Rows were marked two feet apart, and in these corn was dropped, three grains to the hill, the hills being two feet apart. It was cultivated three times, and the few weeds that were not thus destroyed were removed with the hoe.

About three acres in third plot were planted with White Australian flint corn, a variety grown upon the farm for several years past. The growth of the corn on this plot was the most perfect I ever saw in all respects. It stood perfectly even in thickness and height over the whole plot. The suckers were numerous and the leaves green and healthy from ground to tassel. The main stalks stood between eight and nine feet high. Although seemingly as thick as it could be and yet keep its deep green color, quite good sized ears of corn formed, and these while in the milk were cut up with the stalks and went into the silo. The third plot was similar in all respects to the second, except that it was planted with a

southern variety of corn called the "Evans," obtained from the Missouri State University through the kindness of Prof. S. M. Tracy. The stalks on this plot stood between eleven and twelve feet high; were leafy from ground to tassel; were coarse, and the few ears that started were borne from six to eight feet from the ground. This piece was planted in the same manner as the flint corn just mentioned.

YIELD OF ENSILAGE PER ACRE.

Such marvelous stories have been told of the yield of fodder corn for ensilage that cautious farmers have looked upon the whole question of ensilage as one possessing entirely too much fiction for practical purposes. Fields of fodder corn have been *estimated* to yield twenty, forty, sixty and even seventy tons per acre, as we read in the papers. To help settle the question of yield, therefore, the fodder from each plot was weighed. Every load of fodder corn before being driven to the cutter was carefully weighed, and the results as given are the totals of these weights. On the first and second plots all the fodder corn was not converted into ensilage. The yield given is, therefore, for part of the field only.

From the first plot, or that planted with yellow dent corn in drills, the yield from 2.22 acres was 53,762 pounds. This would give 24,212 pounds per acre, or about twelve tons.

From the second plot, planted with flint corn, 2.6 acres of fodder corn were removed, weighing 86,570 pounds, or 33,296 pounds per acre. This gives about 16½ tons per acre. In the third plot there was only .15 of an acre, which yielded 6,420 pounds of fodder corn, or 42,800 pounds, about 21 tons per acre. A single stalk from this plot weighed five pounds, and was twelve feet in length. I do not doubt but that larger crops of fodder corn can be raised than the above, but I maintain that the average of the three will be up to the average crop on most farms.

FILLING THE SILO.

After being weighed the loads of fodder were driven into the barn and the fresh green fodder was run through the Cycle ensilage cutter, which was placed on the barn floor so that the fodder passed from the cutter through a spout into the silo. It has been

stated by writers on ensilage that two horses in a tread power will cut four tons of fodder per hour, into three-fourths inch length. I think this statement misleading, though of course different machines will give different results. Our farm teams have worked for many years past in a tread power, sawing about two hundred cords of wood each fall, with a buzz saw. We found this power insufficient to run the cutter at a good speed. We were, in fact, obliged to stop work, close up the silo and procure a sweep power, such as is used for running threshing machines, to enable us to prosecute the work with any rapidity. Four horses, with such a power, will do the work in proper manner. When doing the best work, with knives sharp and everything in order, we cut 120 pounds of three-fourths inch ensilage per minute, from actual tests.

We are using the same sweep power this winter for sawing wood that was used for the ensilage, and I judge from the way the teams draw, that it requires as much power to saw one cord of dry, four-foot maple wood into three lengths as it does to cut three tons of fodder corn into three-fourths inch ensilage. By using the threshing machine horse power, the farmer is in condition to crowd the work, which if it drags is most annoying and expensive. It requires about as many hands as for threshing grain and is as hard work in every way.

The ensilage, as fast as it passed from the cutter into the silo, was spread and tramped down, but no material of any kind, as salt or lime, was used to preserve it. While filling the silo we had many visitors, as notices were placed in the city papers and several hundred postal cards were sent inviting prominent farmers from different parts of the state to witness our work. The comments were as varied almost as the visitors. As the weather was very warm the ensilage heated rapidly, and when the visitor would run his hand down into the mass of damp-cut fodder and find it so hot as to be uncomfortable, there would sometimes come a shake of the head and prediction of failure of some sort. "It will burn the barn up;" "May keep below but will not on top;" "Think it will be all right above where it can get some air, but below it will make a nice manure heap."

After putting in the fodder from the three plots enumerated, to-

gether with 2,470 pounds of sweet corn and 1,000 pounds of Honduras sugar cane, and tramping all down firmly, we found that the silo was filled to within one foot of the top. That is, 150,222 pounds of the cut fodder occupied a space of 4,536 cubic feet, or 33 pounds per cubic foot. Of course the space occupied varies greatly with the depth of the fodder, the fineness to which it is cut and the thoroughness with which it is tramped.

CLOVER FOR ENSILAGE.

As soon as the cutter stopped, a team was hitched to the mower and we cut all the second growth clover we could get. As fast as a load was cut it was drawn to the silo and put in without having been run through the cutter. In this way five tons were put in. One of the loads of green clover was drawn in during a rain storm, and one load stood on the wagon out of doors in the rain over night, and water was dropping from it when pitched into the silo the next morning.

COVERING THE SILO.

After putting in the green clover it was carefully spread and trampled down in order that it might settle evenly. When this had been done the clover extended about half way up the plank wall; that is, it was about two and a half feet thick. Directly upon the clover were placed two-inch plank ten inches wide, extending across the silo from wall to wall. The plank were cut about an inch shorter than the silo was wide, so that in settling there should be no danger of binding.

Having laid the plank over the clover like a floor, we proceeded at once to put on stone which had been previously collected from the fields about the farm and brought to the barn and piled up after having been weighed. Loads of these were drawn directly into the barn, and the boulders were passed into the silo through the same opening that the ensilage had been passed in at. Four men with one team placed eighteen tons of stone in half a day. This gave a weight of 112 pounds to the square foot. It is probable that a less weight would have done, but the clover was showing great heat and was so long and matted that it could not be easily compressed like short cut corn stalks. Knowing that if the

air could be forced out the heating must cease, we endeavored to make the check effective as soon as possible.

The use of pressure does not seem to be understood by some. It is best explained when we reflect that the heating of any material, as of green fodder, can only go on where air is supplied. Cut off the supply of air and the heating must cease, just as certainly as a fire in a furnace will die out if the supply of air is cut off. Again, to many the stone weights used are a great bugbear, and they would offer a set of jackscrews as something more to the purpose. To all such I would say that the stone need give no trouble, for it is the smallest part of the work to place them. When not obtainable use cordwood or sacks of grain.

After closing up the silo as described, there were scarcely any signs of the change going on in its contents. Occasionally there was a slightly acid odor discernable, but this was not at all marked. The contents settled until the top of the clover layer was four feet below the top of the stone wall. The clover layer was about a foot thick. We see, then, that the cut corn fodder which, when fresh, filled the silo fourteen feet, sunk to ten feet.

COST OF FILLING THE SILO.

The cost of filling the silo was as follows:

38 days' work, at $1.50	$57 00
8 days' work, at 1.75	14 00
15 days' work, at 1.25	18 75
15 days' teams, at $3 00	45 00
Total	$132 75

The time occupied in the work was about six days. As eighty tons of clover and fodder went into the silo, the cost per ton for putting it in is over one dollar and sixty cents. This is fully twice what it should have been, owing to the most aggravating blunders. In the first place the Cycle ensilage cutter from the New York Plow Company failed to work almost as soon as it was started, and caused a loss of over half a day, while a mechanic was employed to fix it. Again, relying upon the statement that two horses in a tread power were sufficient to work it, we made use of a power employed in sawing wood for the univer-

sity, and, after nearly killing the team, abandoned it, and secured a threshing machine sweep power on which four horses were used.

In making these changes so much time was required that we were obliged to place the plank over ensilage already cut, and weight them down with stone, as though we had finished. Upon resuming work again, the stone and plank had to be removed, of course. Beside these annoyances, we found that the knives of the cutter were of such poor quality that they required grinding every three or four hours.

If the experiences of the farm are of any avail in helping others to be cautious and to make due allowance for newspaper accounts and manufacturers' statements, our labors will not have been in vain. It must be remembered that to handle three or four tons of long green fodder every hour, from field to wagon and from wagon to cutter, and thence into the silo, requires a good force of hands, and all arrangements perfect, if economy is to be considered.

OPENING THE SILO.

The silo was opened November 29th, by throwing out the stone resting on four of the plank at the end farthest from the barn and removing them. The clover under the plank was partly decayed for about half an inch down, and below this it was mouldy for two or three inches. Close to the walls all the clover was more or less mouldy. As before stated the clover layer was about a foot thick resting on the corn. The whole of it looked so inferior that I had it thrown out of the door at the end of the silo upon the ground below. Here it remained for several days, receiving no thought except that it was so much lost clover, and that as soon as the teamster had a spare hour it should go to the manure heap.

By using a hay knife one could cut down through the ensilage, making a straight wall on the uncovered side. The fodder corn was in fine order from the top, though dryer than I had supposed it would be. As we dug deeper it became more and more moist, but not so wet as to drip water. This, as all ensilage, is of a brown color and has the characteristic odor and taste.

Upon offering the ensilage to the farm cows, three out of the twelve refused to eat it. Those that ate seemed puzzled over it,

and showed plainly by their cautious mincing manner that they could not quite understand what it was. Those that refused it entirely at first soon fell to tasting it, and after four or five feeds they all ate it as naturally as hay.

Four or five days after the clover had been thrown out of the silo, I noticed that the cows when passing that way stopped and fed upon it. Scarcely believing then that they would eat much of it, we tried it in their mangers, and found that they ate it greedily; they even ate much of that which was musty, so that but a few forkfuls remained.

The ensilage is taken from the silo by means of a large box provided with an iron bail and a bottom made of two doors, which open from the middle outwards and letting the ensilage drop. Running along under the peak of the roof over the silo is a track such as is used for the horse hay fork carrier. Upon this are the same carrier and attachments that are used with the hay fork in summer. When the box is filled, a horse is hitched to the rope running outside the silo, the load is raised to the ridge track, along which the carrier takes it to the outside of the building, where the doors of the box are opened, and the ensilage is dropped into a shute, from whence it drops into a car and is taken to the stock barn near by. I do not claim anything peculiarly economical in this arrangement, but urge upon those who think of building a silo to plan most carefully to avoid the necessity of handling the ensilage often, or carrying it far. It is bulky food, and whether or no it is profitable must depend largely upon how economically it can be handled.

It was planned to feed ensilage along with fodder corn cut from the same lot and thus find the comparative values of the two, but the rainy fall so spoiled the fodder corn that this project has been abandoned and the trial is now between meadow hay and ensilage. Two milch cows are being fed ensilage, and two others hay, both lots having all they wish to eat. Beside this they have equal quantities of bran and oil meal. At this writing, the experiment has been in progress but a few days, but now seems to indicate that more milk will be obtained from the ensilage than from the hay.

A SIMPLE SILO.

A little way from the farm barns near a railroad cut, a hole was dug in the ground, having each of its measurements eight feet. The spot was chosen near the railroad cut to secure good drainage, as most of the land about the farm buildings is low. The soil was compact and gravelly. Into this hole, green clover directly from the field was thrown, and tramped down as closely as possible; the hole was filled, and clover added until it formed a mound rising above the level of the ground. Upon this, straw was placed and a few short boards, and then part of the earth taken from the pit was thrown back upon it, making a mound as is often done in burying roots for winter. In a day or two, the weight of the earth had pressed everything below the level of the ground. Earth was again heaped up, and in a few days the process was repeated. At length, when about two-thirds of the earth had been thrown back, the settling ceased and the earth over the clover was on a level with the surface of the ground. Of course this brought a great pressure to bear upon the clover, but the fall was so extremely wet that since I had placed no protection of any sort over the spot, I supposed the clover had spoiled. A few days since, the hole was opened and the clover came out in perfect condition. Cows eat it greedily. It is very moist and has not lost all of its natural color.

It should be understood that there was no protection of any kind to the bottom or sides of this miniature silo, and only a little straw and a few boards on top of the clover, besides the earth. Burying a green hay crop in this way is of course not a practicable method, but for those who wish to test ensilage in a small way, it is not a bad experiment. It shows, also, how those living where the subsoil is very compact, could make a silo with either very light walls or none at all.

EXPENDITURES FOR AMBER CANE AND ENSILAGE EXPERIMENTS.

The following is an itemized statement of all expenses incurred and moneys expended to date; as shown by the books of the secretary of state, with whom the vouchers are deposited.

W. A. HENRY.

April 26	To Democrat Printing Co.— 3,000 twelve-page pamphlets	....	$26 25
May 4	To Charles H Besley & Co.— 75 ft. 3-6 brass rod, at .08	....	6 00
June 17	To Crane Bros Manufacturing Co.— 1 2 in. union	$0 72	....
June 17	2 ¾-in. globe valves, at $1.30	2 60	....
June 17	1 ½-in. union	19	....
June 17	2 ½-in. globe valves, at .95	1 90	....
June 17	1 ¾-in. union	23	....
June 17	4 1½-in. globe valves, at $3.60	14 40	....
June 17	1 1½-in. tee	40	....
June 17	2 ½-in. globe valves, at .95	1 90	....
June 17	1 ½-in. cross	10	....
June 17	3 1½-in. ells, at .32	96	....
June 17	4 1½-in. tees, at .40	1 60	....
		$25 00	....
June 17	40 per cent	10 00	....
			15 00
June 17	40 ⅜-in. by 1¼-in. machine bolts	$1 44	....
June 17	60 per cent	86	....
			58
June 17	50½ lbs. copper for coil, at .36	$18 18	....
June 17	53 hours' labor making coil, at .50	26 50	....
June 17	7½ lbs. 1½ heavy brass tubing, at .45	3 38	....
			48 06
June 17	box and cartage	....	1 00
June 17	draft	....	25
June 23	To W. J. Rohrbeck— 2 nests lipp. beakers, 6-in. nest, 1—16, at $1.10	$2 20	....
June 23	2 nests do., 4-in nests, 1—8, at .62½	1 25	....
June 23	2 nest beakers, 12-in., nest No. 00 to 10	5 00	....
June 23	3 doz. Bohem. flasks, flat-bottom, 8 oz. at $1.50	4 50	....
June 23	½ doz. Bohem. flasks, flat bottom, 16 oz	1 13	....
June 23	1 analyt. funnel, 3½ oz	2 00	....
June 23	1 Ribl. funnel, 3 oz	1 75	....
June 23	2 plain funnels, 10-in., at 35	70	....
June 23	2 plain funnels, 5-6 in. at .25	50	....
June 23	6 each W. tubes 5½ and 10-in	4 05	....
June 23	6 Liebig's calc. chlor. tubes	90	....
June 23	2 Burettes W. Geiseler's stopcock, 50-in 1-10 c'c'	5 00	....
June 23	2 Burettes W. Geiseler's stopcock, 100-in. 1-5 c'c'	5 50	....
June 23	2 Mohr's burettes 50-in. 1-5 c'c'	3 00	....
June 23	2 Mohr's burrettes, 100-inch 1-5 c'c'	4 00	....
June 23	2 Bink's burettes, 1 each, .25 and .50	2 00	....
June 23	2 graduat. pipettes, 1 each, 10 and 20 c'c'	1 25	....
June 23	2 volum. pipettes, 1 each, 10 and 20 c'c'	50	....

June 23	To W. J. Rohrbeck — continued.		
June 23	12 conic precip. jars	$3 00	....
June 23	2 hydrometer jars, 10 in.	75	....
June 23	2 calc. chloride jars, 12x1½ in., $1.25	2 50	....
June 23	4 Peligots nitrogen tubes	1 25	....
June 23	2 Will. and Varrentr. tubes	75	....
June 23	24 combustion tubes, 8 in., at .30	7 20	....
June 23	6 brass corkborers	1 50	....
June 23	2 graduat. cylinders, 500 c'c'	3 00	....
June 23	2 graduat. cylinders, 300 c'c'	2 50	....
June 23	2 graduat. cylinders, 100 c'c'	2 00	....
June 23	4 Marchand's lactobutyrometers	2 50	....
June 23	2 per cent. saccharometers	1 60	....
June 23	2 Baume's saccharometers	1 20	....
June 23	1 lactometer	50	....
June 23	2 chemic. thermom., C. scale on paper	1 50	....
June 23	2 chemic. thermom., C. scale on milk-glass	3 00	....
June 23	6 plain Bun's gaslamps	3 00	....
June 23	1 upright Fletcher's gas blowpipe	3 50	....
June 23	1 gas combus. furnace, 15 burners	22 00	....
June 23	2 porcelain casseroles, 4 oz., at .40	80	....
June 23	2 porcelain casseroles, 12 oz., at .80	1 60	....
June 23	1 porcelain casserole, 20 oz.,	1 25	....
June 23	4 platin. capsules, 1⅝ diam., at $5	20 00	....
June 23	1 crucible, 1⅜x1 5-16 inches	9 00	....
June 23	1 combus. boat	3 50	....
June 23	3 fresen. desiccators, at $1.75	5 25	....
June 23	2 cases and packing (½ charges)	2 00	....
June 23	1 Bun's gaslamp, with 3 tubes	1 75	....
June 23	draft	50	....
			$154 13
June 21	To Crane Bros. Manuf'g Co.—		
June 21	4 pieces ⅜ blk. tin pipe, 7 lbs., at .36	$2 52	....
June 21	box	25	....
		$2 77	
June 21	Less overpay on last account	25	
			2 52
June 27	To W. A. Henry—		
June 27	stationery and postage	....	25 00
June 29	To W. J. Rohrbeck—		
June 29	analyt. balance, 200 grms., cap. w., ½ knife edges and bearings of agate, etc.	100 00	....
June 29	1 set gramme weights, 200 grms., from 100 grms. down	12 50	....
June 29	4 globul. stopper funnels, w. Geiseler's stop-cock, at $1.25	5 00	....
June 29	24 large velvet corks, 5-20 to 35 in.	75	....
June 29	case, packing, etc., ½ charges	1 50	....
		$119 75	
June 29	less express freight charges to Madison	3 50	....
		$116 25	....
June 29	express	6 05	....
			122 30
July 5	To J. P. Lightbody —		
July 5	labor in month of May on cane machinery, 5 days, 7 hours, at $2.50 per day	14 25	....
July 5	labor in June, 15 days, 3 hours, at $2.50 per day	38 75	....
			53 00

July	25	To W. J. Rohrbeck —		
July	25	1 iron hand press, 1 qrt. cap	$4 50	
July	25	less 10 per cent	45	
			$4 05	
July	25	puorimzets	50	
			$4 55	
		off amount overpaid on last bill paid	50	
				$4 05
July	28	To T. P. Joyce —		
July	28	Labor removing boiler out of building, painting and loading, also work on box and loading the same, 50 hours at 50 cents per hour	$25 00	
July	28	material for box	2 50	
July	28	cartage	2 00	
				29 50
July	1	To C. W. Heyl —		
July	1	2 square pans of galvanized iron	$19 60	
July	1	2 copper cylinders	14 95	
July	1	couplings, faucets, and work on cylinders	17 75	
July	1	galvanized iron, can for cooler, faucet	3 85	
July	1	lining vacuum pan, 47 pounds copper	15 05	
July	1	work on vacuum pan, worm and coupling	28 00	
July	1	copper kettle	5 50	
July	1	4 milk pans, funnel, pint measure	90	
				105 60
Aug.	1	To W. A. Henry —		
Aug.	1	Freight on steam boiler from Janesville, and cartage		11 10
Aug.	1	To Kent & Lawrence—		
Aug.	1	1 steam boiler	$2 50	
Aug.	1	1 centrifugal machine	25	
				275 00
Aug.	2	To Warnes & Swenson —		
Aug.	2	1,266 ft. common boards, at $15	$18 99	
Aug.	2	712 ft. stock boards, at $20	14 24	
Aug.	2	636 ft. 2 by 4 studding, at $15	9 54	
Aug.	2	168 ft. 4 by 4 sills, at $15	2 52	
Aug.	2	252 ft. 2 by 6 joist, at $15	3 78	
Aug.	2	5 000 shingles, at $3.50	17 50	
Aug.	2	80 lbs. nails, at .04	3 20	
Aug.	2	20 lbs. nails, at .05	1 00	
Aug.	2	240 ft. ogee battens, at $30	7 20	
Aug.	2	16 ft. ridge-boards, at $20	32	
Aug.	2	80 ft. flooring, at $30	2 40	
Aug.	2	4 g. sash, at .60	2 40	
Aug.	2	hardware	1 47	
Aug.	2	10½ days' labor, at $2.50	26 25	
				110 81
Aug.	2	To J. P. Lightbody —		
Aug.	2	labor on cane machinery for month of July, 20 days, 2½ hours, at $2.50 per day		50 62
Aug.	3	To Madison Manufacturing Company —		
Aug.	3	one-half cost of flask for vacuum pan	$3 50	
Aug.	3	15 lbs. 1⅝ round iron, at .05	75	
Aug.	3	393 lbs. vacuum pan casting, at .06	23 58	
Aug.	3	53 lbs. castings, at .05	2 65	
				30 48

Aug. 3	To Wm. Cory —		
Aug. 3	33 lbs. brass, at .14	$4 62	....
Aug. 3	20 lbs. brass, at .12½	2 50	....
Aug. 3	28 lbs. copper, at .15	4 20	....
			$11 32
Aug. 5	To Hollister's Pharmacy —		
Aug. 5	7 lbs. ether, at .80	$5 60	....
Aug. 5	2 bottles	32	....
Aug. 5	express	50	....
Aug. 5	½ lb. cause potash	50	....
Aug. 5	1 lb. R. salts	50	....
Aug. 5	1 bot. ether	80	....
			8 22
Aug. 6	To D. Goldenburger —		
Aug. 6	1 second-hand tub	$2 00	....
Aug. 6	1 new made tub	5 00	....
			7 00
Aug. 12	To Joseph Lister —		
Aug. 12	100 lbs. bone charcoal	....	3 85
Aug. 22	To Prof. W. A. Henry —		
Aug. 22	freight on ensilage cutter	....	6 27
Aug. 23	To S. Williams —		
Aug. 23	26 bus. lime	$7 28	....
Aug. 23	26 bus. lime	7 28	....
Aug. 23	18 bus. lime	5 04	....
			19 60
Aug. 26	To Alex. H. Main, Ins. Agt.—		
Aug. 26	insurance on Amber cane machinery	....	33 30
Aug. 27	To Schmidtz & Kienar —		
Aug. 27	21 cords of stone, at $2.50	....	52 50
Aug. 27	To Warnes & Swenson —		
Aug. 27	700 ft. com. boards, at $15.00	$10 50	....
Aug. 27	500 ft. stock boards, at $20.00	10 00	....
Aug. 27	1,138 ft. 2 by 10 plank, at $15.00	17 07	....
Aug. 27	144 ft. 2 by 6 studding, at $15.00	2 16	....
Aug. 27	644 ft. 2 by 4 studding, at $15.00	9 66	....
Aug. 27	32 ft. ridgeboards, at $20.00	64	....
Aug. 27	5¼ M shingles, at $3.50	18 38	....
Aug. 27	55 lbs nails, at .04	2 20	....
Aug. 27	20 lbs. nails, at .05	1 00	....
Aug. 27	46 ft. scantling, at $15 00	69	....
Aug. 27	9½ days' work, at $2 50	23 75	....
Aug. 27	42 ft. flooring, at $30.00	1 26	....
Aug. 27	6 days' work, at $2.50	15 00	....
			112 31
Aug. 30	To Esser & Oakey —		
Aug. 30	25 days' mason's labor, at $3.00	$75 00	....
Aug. 30	12 days' laborer, at $1.75	21 00	....
Aug. 30	320 white brick	2 90	....
			98 90
Aug. 31	To Madison City Gas Light & Coke Co.—		
Aug. 31	gas consumed, 200 cu. ft., at $4.50	$0 90	....
Aug. 31	rent of meter	25	....
		$1 15	
Aug. 31	Less discount when paid before 10th of mo.	20	....
		95	
Aug. 31	12 ft. 1½-in. pipe, at .13	$1 56	....
Aug. 31	1 1½-in. elbow	32	....
Aug. 31	1 1½-in. brass stop cock	2 60	....
Aug. 31	1 wooden stop box	1 00	....

Aug.	31	To Madison City Gas Light & Coke Co.—con.		
Aug.	31	18 hours' labor, at .15	$2 70	... .
Aug.	31	18 hours' labor, at .25........	4 50	....
				$13 63
Sept.	2	To Democrat Printing Co.—		
Sept.	2	400 postal cards, and printing...........	....	5 25
Sept.	3	To Thomas Regan —		
Sept.	3	2 3/8 check valves, at .55..................	$1 10	....
Sept.	3	1 oil cup, $1.25, and 1 3/8 tee, at .15	1 40	....
Sept.	3	2 3/8 steam cocks	1 20	....
Sept.	3	1 piece gas pipe	15	....
Sept.	3	6 ft. 3/4 cal. pipe, at .11½.................	69	....
Sept.	3	5 3/4 return bends, at .19	95	....
Sept.	3	1 1 by 3/4 elbow. at .09.................	09	....
Sept.	3	11 3/4 return bends, at .19	2 09	....
Sept.	3	telegraph charges, .45; express, .50	95	....
Sept.	3	16⅘ ft. 3/4 pipe, at .08.................	1 35	....
Sept.	3	1 3/4 bushing, .7; 1 1/2 bushing, .6..........	13	....
Sept.	3	2 3/4 elbows, .09; 2 3/4 tees, at .12..........	42	....
Sept.	3	15½ ft. 3/4 pipe, at .08........	1 24	....
Sept.	3	1 3/4 union, .20; 1 1-inch tee, .19..........	39	....
Sept.	3	1 3/4 tee, at .12.................	12	....
Sept.	3	100 ft. 3/4 pipe, at .08..............	8 00	....
Sept.	3	3 1½ tee, at .19; 7 3/4 tee, at .12...........	1 41	....
Sept.	3	4 3/4 union, at .20.......................	80	....
Sept.	3	2 3/4 elbows, at .09...	18	....
Sept.	3	16⅔ ft. 3/4 pipe, at .08; 2 3/4 elbows, at .09..	1 51	....
Sept.	3	24⅔ ft. 1½ pipe, at .27; 3 1½ tees, at .33..	7 65	....
Sept.	3	1 1½ elbow, .30; 2 3/4 elbows, at .09	48	....
Sept.	3	1 1½ bushing, .10; 1 1½ bushing, at .10..	20	....
Sept.	3	labor cutting	1 00	....
Sept.	3	7 3/4 globe valves; 1 5/8 glass tube	7 30	....
Sept.	3	9 hours for two putting in water pipe......	4 05	....
Sept.	3	17 ft. 1/2 pipe, at .07	1 19	....
Sept.	3	3 3/4 unions, at .20; 2 1/2 elbows, at .06	72	....
Sept.	3	1 1-inch plug, at .06; 1 1/2 nipple, at .7....	13	....
Sept.	3	95⅔ ft. 1-inch pipe, at .11½	11 00	....
Sept.	3	1 1 by 3/4 elbow, .09; 1 3/4 tee, at .12.......	21	....
Sept.	3	2 3/4 globe valves, at $1 00.	2 00	....
Sept.	3	16½ ft. 1-inch pipe, at .11½.	1 82	....
Sept.	3	1 1/2 elbow, .06; 1 3/4 check valve, .55	61	....
Sept.	3	4 3/4 elbow, at .09; 1 3/4 tee, at .12.........	48	....
Sept.	3	2 reducing couplings, 1 by 3/4, at .15.......	30	....
Sept.	3	4 3/4 unions, at .20; 6 ft. 1/2 pipe, at .07...	1 22	....
Sept.	3	43¾ ft. 3/4 pipe, at .08............	3 50	....
Sept.	3	4 3/4 elbows, .09; 1 3/4 tee, .12; 1 1/2 elbow, .06	54	....
Sept.	3	25 ft. 1 in. rubber pipe, at .27	6 75	....
Sept.	3	3 ft. 3/8 pipe, 5½; 4 3/4 elbows, at .09.......	53	....
Sept.	3	1 3/4 reducer, at .10; 1 3/8 coupling, at .05..	15	....
Sept.	3	1 3/4 globe valve	1 00	....
Sept.	3	1 1-inch globe valve	1 20	....
Sept.	3	150 ft. gas pipe, at .12.	18 00	....
Sept.	3	4 pillar cocks, at .30....................	1 20	....
Sept.	3	5 nipples, at .05; 1 3/8 plug, at .05.........	30	....
Sept.	3	4 burners, at .15; 1 pr. meter connections, $3.	3 60	....
Sept.	3	1 1-inch stop cock......................	1 25	....
Sept.	3	1 1/2 reducing coupling, .20; 1 1/4 elbow, .20	40	....
Sept.	3	1½ days for laborer, at $1 50....	2 25	....
Sept.	3	2½ days for man and helper, at $4 50......	11 25	....
Sept.	3	1 3/4 bibb cock for water pipe	2 00	....
Sept.	3	1 3/4 tee, .12; 2 straps. .05	17	....
Sept.	3	1 1/2 coupling, .05; 1 1/2 nipple, .05	10	....

Sept. 3	To Thomas Regan — continued.		
Sept. 3	6 ½ elbows, at .06; 1 ½ globe valve, .85..	$1 21	....
Sept. 3	1 pillar cock	30	....
Sept. 3	60 ft. 1-inch pipe, at. 11½..................	6 90	....
Sept. 3	3 1-inch elbows, at .09....................	27	....
Sept. 3	50 ft. ½ pipe, at .07.....................	3 50	....
Sept. 3	1 ½ tee	09	....
Sept. 3	2 days for man and helper, at $4.50	9 00	....
Sept. 3	labor for making coil.....................	10 00	....
Sept. 3	8 ft. ¾ pipe, at .08	64	....
Sept. 3	1 1-inch reducing coupling................	10	....
Sept. 3	1 1-inch bushing	08	....
		$151 81	....
Sept. 3	Cr. by 15 8/10 rubber pipe, at .27..........	4 23	....
			$147 58
Sept. 5	To Prof. W. A. Henry —		
Sept. 5	Pay roll of men employed in putting in ensilage:		
Sept. 5	John Camp, 5½ days, at $1 50	$8 25	....
Sept. 5	H. Halbersleben, 6 days, at $1.75.........	10 50	....
Sept. 5	John B. Smith, 6½ days, at $1.50........	9 75	....
Sept. 5	Frederick Smith, 4½ days, at $1.50........	6 25	....
Sept. 5	Henry Cæsar, 3¼ days, at $1.50..........	4 87	....
Sept. 5	John Kelly, 2¾ days, at $1.50............	4 12	....
Sept. 5	M. Nolan, 1 day, at $1.75	1 75	....
Sept. 5	F. Duffee, 1 day, at $1.75	1 75	....
Sept. 5	H. Fichten, teaming, 2 days, at $3.00.....	6 00	....
Sept. 5	M. Foley, 1 day, at $3.00.................	3 00	....
Sept. 5	Louis Rosan, 5 days, at $1.50	7 50	....
Sept. 5	Ambrose Romyce, 5 days, at $150	7 50	....
			71 74
Sept. 7	To J. P. Lightbody —		
Sept. 7	Labor in August, 11 days, 9 hours, at $2.50..	....	29 75
Sept. 8	To W A. Henry —		
Sept. 8	To cash paid John Wasler for work putting in ensilage, 2 days, at $1.50.............	....	3 00
Sept. 8	To Magnus Swenson —		
Sept. 8	To services in Amber cane experiments from June 1 to September 1, 1881, 3 months, at $100 per month..........................	....	300 00
Sept. 8	To Conkling & Co.—		
Sept. 8	10 barrels Milwaukee cement, at $2.00......	$20 00	....
Sept. 8	1 barrel Milwaukee cement, at $2.00......	2 00	....
Sept. 8	2 barrels Milwaukee cement, at $2.00......	4 00	....
			26 00
Sept. 16	To D. W. Brittan —		
Sept. 16	20 5-gallon syrup kegs, at .30.............	....	6 00
Sept. 18	To New York Plow Co —		
Sept. 18	1 ensilage cutter..........................	....	75 00
Sept. 19	To Frank & Ramsay —		
Sept. 19	12 lbs. 2×½ iron, at .03½.................	$0 42	....
Sept. 19	2 lbs. 5/16 nuts at .12½....................	25	....
Sept. 19	1 bull's-eye lantern.....................	1 00	....
Sept. 19	1 padlock...............................	65	....
Sept. 19	3¼ strap hinges, at .10.................	33	....
Sept. 19	60 flashings, at .02	1 20	....
Sept. 19	3 lbs. 6-penny wrought nails, at .08........	24	....
Sept. 19	14 lbs. nails, at .04......................	56	....
Sept. 19	1 well-wheel hook	12	....
Sept. 19	1 eye bolt..............................	15	....

Sept. 19	To Frank & Ramsay — continued.		
Sept. 19	6 lbs. 20 penny nails, at .04	$0 24	....
Sept. 19	1 piece hoop iron	05	....
Sept. 19	1 wrench	1 25	....
Sept. 19	1 hammer	85	....
Sept. 19	2 taper files, double ends, at .20	40	....
Sept. 19	1 file	60	....
Sept. 19	1 7/8 brass faucet	1 50	....
Sept. 19	1 pair strap hinges	20	....
Sept. 19	1 hook and staple	05	....
Sept. 19	emery paper	15	....
			$10 21
Sept. 22	To M. Swenson —		
Sept. 22	cash paid for barrels	....	10 00
Oct. 1	To W. J. Rohrbeck —		
Oct. 1	glass apparatus	....	3 00
Oct. 10	To Hollister's Pharmacy —		
Oct. 10	copper and lead	$6 75	....
Oct. 10	barium and alum	4 50	....
			11 25
Oct. 12	To Joseph Lister —		
Oct. 12	2 packages bone charcoal, net 300 lbs., at $3.85 per 100 lbs	....	11 55
Oct. 15	To F. W. Holt —		
Oct. 15	99 hours' labor at mill at .15 per hour	....	14 85
Oct. 18	To A. B. Burr —		
Oct. 18	192 hours' work at mill, at .15 per hour	....	28 80
Oct. 21	To Madison Manufacturing Co.—		
Oct. 21	8 lbs. wrought iron, at .05	$0 40	....
Oct. 21	55 lbs. wrought iron, at .05	2 75	....
Oct. 21	24 ft. 2-in. rubber belting, at .12½	3 00	....
Oct. 21	2 hours' forging, at .75	1 50	....
Oct. 21	2 sorgho skimmers, at .35	70	....
Oct. 21	5½ lbs. casting, at .05	28	....
Oct. 21	6 ½-in. bolts, at .10	60	....
			9 23
Oct. 20	To W. A. Henry —		
Oct. 20	cash paid for 6 jointed rods, at .25	$1 50	....
Oct. 20	G. Milman, work on ensilage	4 90	....
Oct. 20	M. Folley, work on ensilage	6 00	....
Oct. 20	telegraphing for ensilage cutter	1 00	....
			13 40
Oct. 20	To Magnus Swenson —		
Oct. 20	cash paid for 4 yards muslin, at .9	$0 36	....
Oct. 20	2 yards cotton flannel, at .12½	25	....
Oct. 20	1 pair scissors	50	....
Oct. 20	10 yards cotton cloth, at .04	40	....
Oct. 20	1 yard linen	65	....
Oct. 20	express on charcoal	50	....
Oct. 20	expenses to Janesville	3 70	....
Oct. 20	lime	55	....
Oct. 20	gallon measure	50	....
Oct. 20	lime	30	....
Oct. 20	1 pail, 1 qt	15	....
Oct. 20	1 pail, 4 qt	40	....
			10 26
Oct. 22	To W. A. Henry —		
Oct. 22	cash paid on freight and express bills for packages used in Amber cane experiments	....	8 44
Oct. 22	To J. N. Wilcox —		
Oct. 22	231 hours' labor at cane mill, at .15	....	34 65

Oct. 22	To J. F. Bruce & Bro.—		
Oct. 22	2 barrels	$2 00	....
Oct. 22	1 tub	85	....
Oct. 22	1 pail	25	....
Oct. 22	1 keg	75	....
Oct. 22	1 tub	85	....
Oct. 22	2 pails	50	....
Oct. 22	1 barrel	35	....
			$5 55
Oct. 31	To S. L. Sheldon —		
Oct. 31	1 30-inch pulley	$15 00	....
Oct. 31	boxes	3 00	....
Oct. 31	shaft	2 50	....
Oct. 31	wood work and bolt for jack	1 50	....
Oct. 31	1 day, 2 men	5 00	....
Oct. 31	30 ft. rubber belting, less $\frac{1}{3}$	11 80	....
Oct. 31	3 2d h. tumbling rods, $\frac{1}{2}$ price	6 00	....
Oct. 31	3 couplings, $\frac{1}{2}$ price	3 00	....
Oct. 31	2 new T. R. blocks	1 50	....
Oct. 31	1 pulley for cutter	3 75	....
Oct. 31	drayage	1 50	....
Oct. 31	$\frac{1}{2}$ day, 2 men setting up	3 00	....
			57 55
Nov. 4	To H. G. Kronke —		
Nov. 4	1 stove	$26 00	....
Nov. 4	11 joints pipe	5 50	....
Nov. 4	2 elbows	50	....
Nov. 4	zinc	1 00	....
Nov. 4	coal hod	85	....
			33 85
Nov. 7	To W. A. Henry —		
Nov. 7	cash paid for cane seed	$2 00	....
Nov. 7	cash paid for telegrams and express charges	1 80	....
			3 80
Oct. 22	To Magnus Swenson —		
Oct. 22	cash paid for 1 torrent steam pump, steam gauge and 1 old glass gauge	....	18 00
Nov. 10	To Democrat Printing Co.— 2,000 circulars, 300 government 3-cent stamped envelopes, 300 XXX No. $6\frac{1}{2}$ envelopes	....	18 00
Nov. 16	To W. J. Rohrbeck — 1 platin. capsule, 3 inch diam. wt. 39 grms. at .42 per grm	$16 38	....
	4 vol. pipette, 2 each 5 and 10cc .. $1 00		
	3 lbs. C. P. Rochelle salt 3 75		
	$4 75		
	less 10 per cent 47		
		4 28	....
	packing	22	....
			20 88
Nov. 25	To Joseph Lister —		
Nov. 25	3 packages bone charcoal, net, 541 lbs., at $3 85 per 100 lbs	....	20 82
Nov. 28	To C. I. King —		
Nov. 28	use of tools in constructing sugar cane apparatus	....	30 00
Dec. 3	To Democrat Printing Co.—		
Dec. 3	1 M $\frac{1}{4}$ sheet circulars	....	5 00
Dec. 5	To Bunker & Vroman —		
Dec. 5	340 ft. plank, at $15 00	....	5 10

Dec. 14	To J. N. Wilcox —		
Dec. 14	labor in October, 276 hours, at .15	$11 40	
Dec. 14	labor in November, 96 hours, at .15	14 40	
Dec. 14	labor in December, 4 hours, at .15	60	
			$56 40
Dec. 15	To Hollister's Pharmacy —		
Dec. 15	1 lb carb. lime	$0 25	
Dec. 15	1 gross quinine bottles	8 75	
Dec. 15	1 gross 4 oz. U. ovals	4 50	
Dec. 15	1 gross corks for quin. bottles	80	
Dec. 15	1 gross corks	20	
			$14 50
Dec. 27	To Magnus Swenson —		
Dec. 27	salary as chemist from Sept. 1, 1881, to Jan 1, 1882		400 00
Dec. 28	To John Kempf —		
Dec. 28	391 hours labor, at .15 per hour		58 65
Dec. 30	To Democrat Printing Co. —		
Dec. 30	200 labels for sugar boxes		2 00
Dec. 30	To Magnus Swenson —		
Dec. 30	express charges	$0 80	
Dec. 30	expenses to Janesville	2 40	
Dec. 30	stationery	1 13	
			4 33
Dec. 30	To C. W. Heyl —		
Dec. 30	smoke-stack, 82½ lbs	$10 25	
Dec. 30	2 covered pails and piece of iron	75	
Dec. 30	galv. iron tank, 42 lbs	8 40	
Dec. 30	dipper and scoop	40	
Dec. 30	2 copper boxes, shelf and stand	10 50	
Dec. 30	76 tin boxes	7 60	
			37 90
Dec. 30	To W. A. Henry —		
Dec. 30	postage on circulars		14 14
Dec. 30	To W. A. Henry —		
Dec. 30	cash paid for 200 cu. ft. gas, at $4.50 per 1,000	$0 90	
Dec. 30	rent of meter	25	
		$1 15	
Dec. 30	discount	20	
		$0 95	
Dec. 30	expressage	40	
Dec. 30	expressage	25	
Dec. 30	2 barrels	2 00	
Dec. 30	freight	1 89	
			5 49
	Total expense to date		$3,080 07